Firms′ adaptation strategies to floods and their potential implication on regional economic development – Insights from Jakarta and Semarang, Indonesia

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Four years ago, I could not imagine to draw up a dissertation thesis about Indonesia. My knowledge of this largest archipelago in the world was restricted to two facts: That it is famous for Bali – the island of the gods, the last dragon of the world, the Komodo and endangered tigers due to the deforestation, and to the fact that Indonesia is oftentimes affected by natural disasters, such as the Boxing Day Tsunami 2004.

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List of abbreviations

BAKORNAS PB	Badan Koordinasi Nasional Penanggulangan Bencana (National Coordinating Board for disaster management)
BAPPEDA	Badan Perencanaan Pembangunan Daerah (District or Provincial Development Planning Agency)
BAPPENAS	Badan Perencanaan Pembangunan Nasional (National Planning and Development Agency)
BNPB	Badan Nasional Penanggulangan Bencana (National Disaster Management Agency)
BPBD	Badan Penanggulangan Bencana Daerah (Regional Disaster Management Agency)
BPS	Badan Pusat Statistik (Central Agency on Statistics)
DM	disaster management
DRR	disaster risk reduction
EM-DAT	Emergency Events Database
EU	European Union
FRRM	flood risk reduction measure
GDP	gross domestic product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Corporation for International Cooperation)
IARD	Integrative adaptive regional development
IFC	International Bank for Reconstruction and Development
IMK	Industri Mikro Dan Kecil (micro and small enterprises)
JEDI	Jakarta Emergency Dredging Initiative
JICA	Japan International Cooperation Agency
JIEP	Jakarta Industrial Estate Pulogadung
KBN	Kawasan Berikat Nusantara (Persero)

KIW	Kawasan Industri Wijayakusuma
LECZ	low-elevated coastal zones
LIPI	Lembaga Ilmu Pengetahuan Indonesia (Indonesian Institute of Sciences)
MSME	micro, small and medium-sized enterprise
NCICD	National Capital Integrated Coastal Development
NGO	Non-governmental organization
OECD	Organisation for Economic Co-operation and Development
PODES	Pendataan Potensi Desa (Village Potential Statistics)
Satkorlak PBA	Satuan Koordinasi Pelaksanaan Penanggulangan Bencana Alam (Provincial Coordinating Agency for Disaster Management)
Satlak PBA	Satuan Pelaksanaan Penanggulangan Bencana Alam (District Level Coordinating Agency for Disaster Management)
SME	small and medium-sized firms
Telkomsel	P.T. Telekomunikasi Selular
TEPZ	Tanjung Emas Export Processing Zone
TFP	total factor productivity
TWIN-SEA	Expert network and twinning institute on climate and societal change for Southeast Asia
UN	United Nations

1 Introduction

Firms always face multi-dimensional risks (e.g., a decline of demand, technological changes), out of which risks related to natural hazards are on the rise in many regions of the world. An intensification of those hazards is becoming increasingly visible (IPCC, 2014). Reasons for this are the climate change that tends to amplify, for instance, flooding, sea level rise, or typhoons, as well as the increase in socio-economic exposure and vulnerability, driven, for example, by coastal urbanization in sensitive low-lying and hazard-prone areas.

Southeast Asia, and especially Indonesia, has been identified as one of the global risk hotspots in this regard, given that it is highly exposed to natural hazards (such as coastal, river flooding, and land subsidence) and potential climate change impacts (BEH, 2017; DASGUPTA et al., 2009; YUSUF & FRANCISCO, 2009). Additionally, there are very dynamic changes in Indonesia′s vulnerability as well as a wider transition process which includes economic development, urbanization, and political change, and all this present the firms with further challenges (GARSCHAGEN & ROMERO-LANKAO, 2015).

Firms in Indonesia, therefore, need to adapt and to accommodate an increasingly complex web of risks and uncertainties related to natural hazards into their business strategy. However, current risk and adaptation research have so far not explored very thoroughly how this entanglement plays out in detail and on what grounds firms are taking their decisions. Much attention has been given to analyze the impacts of natural hazards at the community and household level in developing countries (e.g., BIRKMANN et al., 2012; 2014; CHAN et al., 2012) or to calculate economic costs of disaster (e.g., ADB, 2014; HALLEGATTE, 2014). Research with a focus on firms is burgeoning but rather focusses on estimating losses and damages provoked by natural disasters or firms′ mitigation actions against climate change impacts. A profound emphasis on firms′ adaptation to floods particularly in developing countries and emerging economies[1] is missing, so far; especially, a comprehensive understanding on firms′ actions on the individual and regional level should be of major concern. This research gap is striking, given that the competitiveness and survival of firms are crucial to maintain and improve the welfare in countries exposed to natural hazards, particularly in emerging economies and developing countries, such as Indonesia. Destroyed raw material and machinery, power outages, and supply-chain disruptions affect the competitiveness of firms. This can result in lower outputs, and

[1] Developing countries and emerging economies are defined as lower and upper middle-income countries according to the World Bank (2017) classification. The term ‘Global South’ is interchangeably used in this thesis.

the loss of employment, livelihoods and tax revenues (HALLEGATTE, 2014). The hard-won increase of economic and social welfare is endangered by coastal hazards. Therefore, the question of whether and if so, how firms can deal with changing hazard profiles in their environment is of key concern for understanding, first, their individual competitiveness and, second, trajectories of regional development at large.

Hence, the dissertation thesis emphasizes on two perspectives: first, on firms′ own enhancement of competitiveness (individual adaptation); second, on the role of firms as stakeholders within regional economic development and collective adaptation. Both perspectives combined are supposed to improve the understanding of an integrative adaptive regional development (IARD). Besides, the innovative conceptual framework, this dissertation thesis provides a more profound theoretical understanding of firms′ flood adaptation strategies by proposing an extended typology of contemporary literature. Methodologically, a novel approach, the scenario-based field experiment, is conceptualized and empirically tested in order to detect the willingness of micro, small and medium-sized enterprises (MSMEs) to contribute to joint flood risk reduction measures.

In this respect, the dissertation thesis endeavors to contribute to the burgeoning literature on firms and to the debate of socioeconomic impacts of natural hazards and climate change by providing a deeper understanding of the role of firms. Moreover, recommendations on designing a disaster management policy that takes manufacturing firms more into account are outlined. In doing so, the empirical analysis rests upon manufacturing firms in the case-study regions Jakarta and Semarang.

The following sections provide an overview of contemporary dynamics in Indonesia with regard to natural hazards, regional development policies and the conditions of the manufacturing sector. Moreover, the objectives and the research questions of this thesis are elaborated in more detail.

1.1 Natural hazards in Southeast Asia and Indonesia in particular

Southeast Asia[2] is the most hazard-prone region in the world. Between 2000 and 2017 12.9 % (855 events) of all natural disaster events took place in Southeast Asia, followed by East Asia 12.4 % (820 events) and South Asia 12.1 % (804 events). This particularly applies to the Philippines (278 events), Indonesia (244), and Vietnam (127) who are frequently hit by natural disasters (EM-DAT, 2018). Among the different disaster types, flood events are with 47.5 % (406 of total 855 events) the most frequent disaster, followed by storm surges (28.3 %) and earthquakes (8.7 %) (EM-DAT, 2018). After the Philippines, Indonesia is the Southeast Asian country most exposed to natural hazards (cf. Table 1-1). Indonesia must deal, in particular, with the increasing frequency and intensity of floods (CHAN et al., 2012; FUCHS et al., 2011).

Table 1-1: Occurrence of natural disasters in selected Southeast Asian countries between 2000 and 2017

Disaster type	The Philippines	Indonesia	Vietnam	Thailand	Malaysia
Flood	93	118	62	50	34
Storm	147	5	57	15	5
Earthquake	11	53	0	3	2
Landslide	13	43	4	38	2
Volcanic activity	10	18	0	0	0
Drought	3	4	3	8	1
Total[3]	**278**	**244**	**127**	**81**	**45**

Source: EM-DAT, 2018

The high exposure to floods is driven by local and regional environmental change (notably coastal erosion, land subsidence, and land use change) as well as by climate change (IPCC, 2014). Geographically, the areas with the highest exposure to natural hazards overlap with densely populated and economically active regions, particularly in coastal urban areas (FUCHS et al., 2011).

Taking a closer look at the spatial distribution of the flood risk[4] in Indonesia, it can be indicated that the flood risk is particularly high at low-elevation coastal zones (LECZ)[5] and in coastal

[2] Southeast Asia includes the countries Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor Leste, and Vietnam.

[3] Due to their relatively lower number wildfires (8 events in Southeast Asia), extreme temperatures (2 events) and mass movements (1) are not depicted as separate natural disasters but are included in the total count.

[4] Flood risk is understood as the probability of a flood event. Whereas exposure to floods means the confrontation with a flood risk (UNISDR, 2016).

[5] Low-elevation coastal zones are defined as continuous land zones along the coast and with an elevation of below 10m (MCGRANAHAN et al., 2007).

watersheds (cf. Figure 1-1). Urban expansion along with a land-use change accelerates the flood risk in these areas (FUCHS et al., 2011). High-risk zones are, for instance, the Eastern Sumatra coast, the Northern Java coast, the Southern Kalimantan coast, and the Southern coast of Papua. The map also shows that many of the important Indonesian cities are located on the coast (e.g., Banjarmasin, Jakarta, Semarang, and Surabaya) or nearby (e.g., Medan and Palembang). All these cities face a considerable high flood risk that causes considerable economic losses. Throughout Southeast Asia, economic losses caused by floods have increased more than two-fold in the period of 2004-2014 compared to 1992-2003, while in Indonesia, the increase was even 4.5 times (EM-DAT, 2018).

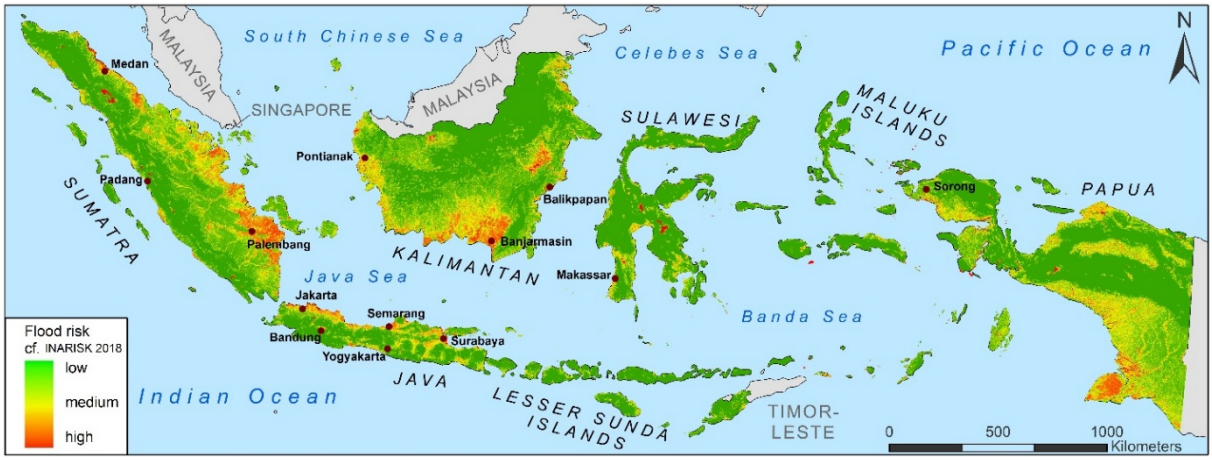


Figure 1-1: Projected flood risk in Indonesia (Design: Thomas Neise and Lena Krist)

In 2000, 18.4 % of Indonesia′s population and one-quarter of its GDP production were located in the LECZ which are increasingly susceptible to sea level rise and flooding (MCGRANAHAN et al., 2007; NEUMANN et al., 2015). A study by NEUMANN et al. (2015) estimated that the population in LECZ will rise to 26.4 % in Indonesia in 2060. After China, India, and Bangladesh, Indonesia will have the fourth-highest population in absolute numbers that is exposed to the mentioned coastal hazards in LECZ.

In these flood risk areas, besides a high share of the population living there, also a high density of manufacturing firms can be found. These location choices make manufacturing firms also very susceptible to business disruptions by floods.

1.2 Evolution of manufacturing firms and challenges for SMEs′ competitiveness

Generally, the manufacturing sector is seen as a crucial player in order to alleviate poverty, provide jobs for the rising population and develop a more advanced economic development that so far still largely relies on natural commodities in Indonesia (PAKPAHAN, 2013; SANDEE, 2009;

WORLD BANK, 2014b). Overall, the manufacturing sector absorbs the highest number of labor force among all main business sectors in Indonesia. Nearly every fifth laborer (19.1 %) is working in the manufacturing sector (BPS INDONESIA, 2017b). The share of the labor force working in the manufacturing sector is in Semarang (22.8 %) higher than in Jakarta (15.7 %). Both in Jakarta and Semarang, the manufacturing sector is the third-largest employer. More labor force is employed in the tourism, wholesale and retail trade sector as well as in social and personal services (BPS DKI JAKARTA, 2006; BPS JAWA TENGAH, 2018).

The manufacturing sector also contributes, as a single business sector, the largest share (23.9 %) to the national GDP. Provinces with the largest contribution of the manufacturing sector are West Java, West Papua, Banten, and also Central Java. Particularly in Java[6], the manufacturing sector is the most significant contributor to the regional GDP. All provinces together stand for 70.5 % of the total Indonesian manufacturing production (BPS INDONESIA, 2017a).

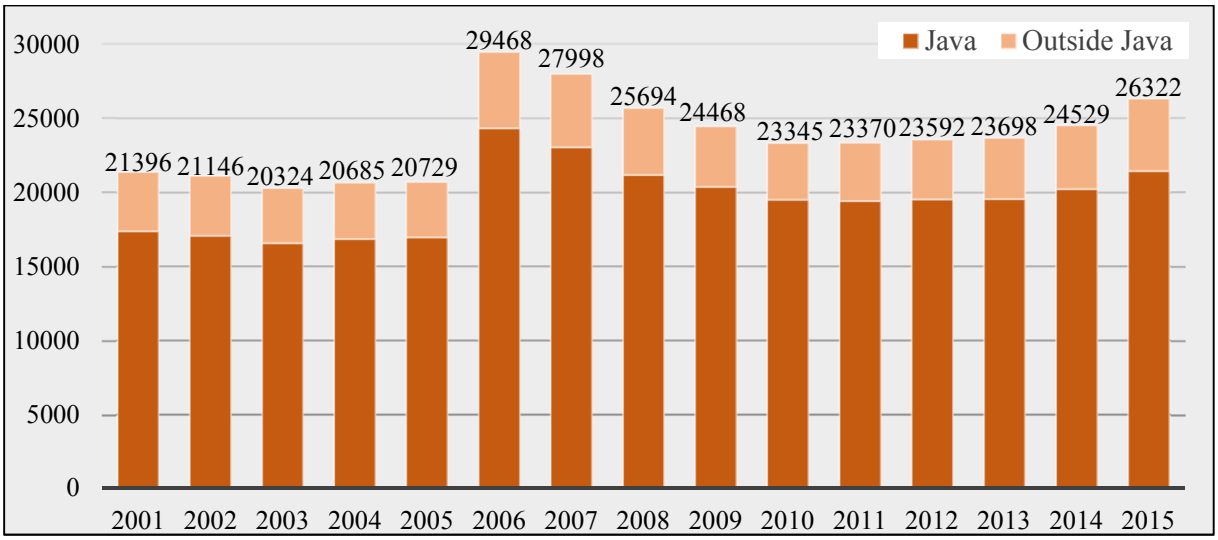
The dominance of Java[7] can also be seen in the number of establishments in the manufacturing sector with a minimum of 20 employees.[8] Typically, economic centers are concentrated in Java. 81.5 % of all manufacturing firms are located on Java (BPS INDONESIA, 2017d). Sumatra, Kalimantan, Sulawesi, and Bali have small economic clusters (SANDEE, 2016). In the aftermath of the Asian financial crisis, the number of establishments in the manufacturing sector was about 21,400. The count of establishments reduced slightly until 2005. After the downturn that started in 2007 and reached its bottom in 2010, the number of manufacturing firms continually increased until 2015. However, the unequal spatial distribution of manufacturing firms in Indonesia maintained from 2001 to 2015. The evolution of manufacturing firms still mostly takes place in Java (cf. Table 1-2).

[6] This includes the provinces Banten, DKI Jakarta, Central Java, East Java, West Java and DI Yogyakarta.

[7] It should be also taking into account that Java is the most densely populated island of Indonesia and more than the half of the Indonesian population lives on Java (BPS INDONESIA, 2016).

[8] If not mentioned differently in the thesis, the data of the manufacturing sector contain all establishments with at least 20 employees. The quoted data from the Central Agency on Statistics (BPS) of Indonesia is based on medium-sized and large firms. BPS defines medium-sized firms as those firms with 20 – 99 employees and large firms with at least 100 employees (BPS INDONESIA, 2015a).

Table 1-2: Number of establishments in the manufacturing sector 2001-2015 in Indonesia[9]



Source: BPS INDONESIA, 2017d

Although Java accounts for the highest number of manufacturing firms overall in Indonesia, the firms are concentrated to a large extent in some metropolitan areas of Java. Figure 1-2 depicts the density of manufacturing firms in all regencies or municipalities[10] of Java. The firms mainly collocate in the metropolitan areas of Jakarta and Surabaya as well as in Bandung, the capital of the province West Java. In the metropolitan area of Jakarta, most firms are located in the surrounding regencies and municipalities of Jakarta (Tangerang, Bekasi, and Bogor), but a high number of firms is also located in Jakarta′s coastal regencies North Jakarta and West Jakarta. A similar pattern can be indicated in the metropolitan area of Surabaya (cf. Figure 1-2).

[9] The huge increase of manufacturing firms in 2006 can be explained by the economic census in 2006. Once every 10 years, the BPS conducts an economic census. As part of the economic census, a more comprehensive data collection is carried out. The annual directory is based on the 'annual survey of medium and large industries' and on cross-checks with lists from other agencies (e.g. Ministry of Industry, regional government offices). About 35 % of all mismatches between two consecutive years are checked in the field (BPS INDONESIA, 2015a).

[10] In Indonesia the provinces are divided into regencies (*kabupaten*) or municipalities (*kota*).

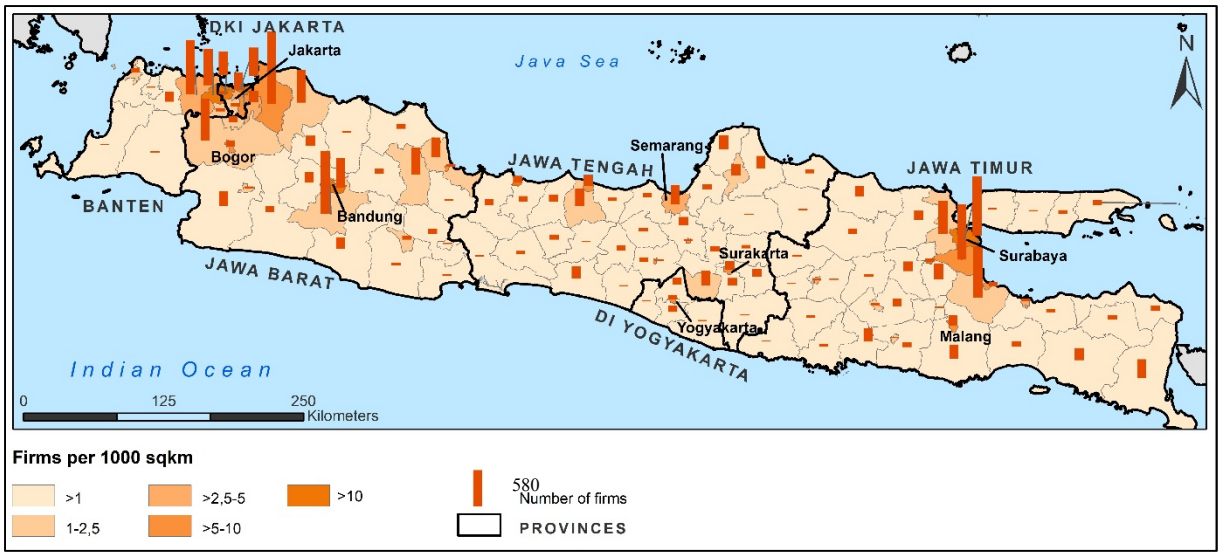


Figure 1-2: Firms′ density on regency or city level 2015 in Java
(Data: Author′s calculation based on BPS INDONESIA, 2015a; Design: Thomas Neise and Lena Krist)

For example in the case of Jakarta, two particular reasons exist for this location pattern. First, since the 1990s, manufacturing firms relocated or established their locations at the main toll roads that are connecting Jakarta with its hinterland, the harbor, and the airport. At the newly established industrial parks closed to the toll roads on Jakarta′s outskirts, mainly large foreign firms are located (HUDALAH et al., 2013). For instance, the number of manufacturing firms increased sharply in the regency Bekasi (+ 104.1 %) between 2001 and 2015.[11] Second, the high number of firms in North, West and East Jakarta can be explained by large (older) industrial parks that are providing proximity or a good connection to the transport infrastructure (i.e., harbor and airport). However, between 2001 and 2015 all of these regencies in DKI Jakarta lost at least 40 % of their manufacturing firms. Nonetheless, all three regencies have one of the highest numbers of manufacturing firms of all Indonesian regencies.[12] In sum, successive sub-urbanization of manufacturing firms can be observed in Jabodetabek[13], but many firms are still located in flood risk areas of Jakarta.

The high number of manufacturing firms in coastal urban areas, such as Jakarta and Surabaya, is not surprising. On the one hand, the close proximity to the harbor and the resulting low transportation costs play an essential role for export-orientated firms (HALLEGATTE 2014). Furthermore, locating assets (e.g., high availability of workers, proximity to supplier-buyer networks)

[11] Own calculation based on BPS Indonesia (2001, 2015a).
[12] Own calculation based on BPS Indonesia (2001, 2015a).
[13] This acronym encompasses the capital region Jakarta and their neighboring cities Bogor, Depok, Tangerang, Tangerang Selatan, and Bekasi as well as the districts Bekasi, Bogor, and Tangerang which have been consolidated to one urban area (WORLD BANK, 2012).

at the coastal areas can increase production if agglomeration externalities from those locating assets are generated (HALLEGATTE 2014). On the other hand, the location at risky coastal areas might be not voluntarily chosen. Firms might decide to locate here due to sparse financial resources and limited alternative location choices. It is also possible that the firms do not precisely assess (future) risk of their potential location. Firms will instead reduce their transaction costs (i.e., money, time and human resources) than to find the optimal location (HALLEGATTE, 2014; LINNENLUECKE et al., 2011).

The study of Rodríguez-Pose et al. (2013) on the determinants of manufacturing firms′ export activities in Indonesia provides an explanation of the benefits of suburban areas of, for instance, Jakarta and Surabaya for those firms. This study shows that besides firms′ internal factors[14] external factors determine whether firms are exporting. Manufacturing firms export when they are collocating with other exporting firms and when they are surrounded by firms in the same industry sub-sector. Furthermore, road density and the education level in the same and neighboring province increase the likelihood of exporting. Interestingly, for the export, the high quality of roads in the neighborhood is more important than the one in the own province. The same is true for the availability of skilled labor in the proximity – this can compensate for the shortage of employment in the own province. These results underpin that manufacturing firms benefit from being close to urban centers.

Moreover, Indonesia′s manufacturing sector is characterized by high dominance of micro and small enterprises. Table 1-3 shows that nearly 99 % of all manufacturing firms in Indonesia are micro or small enterprises with less than 20 employees that are predominately established necessity driven due to poverty than entrepreneurial motives. But these firms provide essential job opportunities for increasing labor forces (PAKPAHAN, 2013). As can be indicated by Jakarta, Semarang, and Bandung, cities have a smaller share of micro enterprises than the national average, but small firms still dominate.[15]

[14] Favorable factors are, for instance, foreign ownership, high TFP, and export experience (RODRÍGUEZ-POSE et al., 2013)

[15] An exception is the second-largest city of Indonesia, Surabaya: This city possesses a considerable higher share of firms that are not micro enterprises. Here, one-third of all located manufacturing firms have at least 20 employees, but the firms are particularly small and medium-sized one.

Table 1-3: Distribution of manufacturing firms with regard to their business size in selected cities in Java (in percent)

Business size[16]	Micro (< 20 employees)	Small (20 < 50 employees)	Medium-sized (50 < 250 employees)	Large (≥ 250 employees)	Total
Jakarta	89.6	5.1	3.5	1.8	11,546
Semarang	90.9	3.1	3.4	2.6	3,426
Surabaya	66.7	18.4	10.4	4.6	2,837
Bandung	91.8	4.7	2.4	1.0	5,728
Indonesia	**98.8**	**0.6**	**0.4**	**0.2**	**1,891,858**

Sources: Own calculation based on BPS INDONESIA 2015a; 2015c

However, the data of table 1-3 shows not the real dominance of the large enterprises – those are oftentimes family-controlled domestic or foreign conglomerates – which dominate many business sectors (CARNEY & DIELEMAN, 2011). In 2015, firms with at least 100 employees accounted for 89.5 % of the entire value creation of the manufacturing sector. Especially the food industry (18.4 %), the production of motor vehicles (11.7 %) as well as chemicals and chemical products (11.6 %) are the industrial sub-sectors that contribute the highest added value of all manufacturing sub-sectors (BPS INDONESIA, 2017c).

A survey (n = 192) conducted by Burger et al. (2015) highlights the challenges that SMEs in Indonesia are facing when they try to achieve higher competitiveness. The enterprises have to deal mainly with constraints on access to credits, raw materials, and markets. Lenders are oftentimes unwilling to provide credits for SMEs or request high-interest rates. Moreover, the study finds that the owners of SMEs tend to avoid risks. Therefore, the owners are also not planning to borrow money from a bank. These limited financial resources are hampering SMEs to invest in new technologies or to increase their output. Concerning raw material, the survey finds that the SMEs have difficulties in purchasing high-quality material. Moreover, high prices on materials, electricity, fuel, and transportation costs constraint the business development of SMEs (BURGER et al., 2015). Burger et al. (2015) also show that SMEs usually serve local markets. According to the IMK survey of 2013[17], two-thirds of all micro and small firms sell all of their products in the district of their site.

[16] The data was derived from two sources: The industry directory 2015 BPS Indonesia (2015a) provided the data for the manufacturing firms with at least 20 employees, and the Village Potential Survey (PODES) (BPS INDONESIA, 2015c) supplied the data for firms with less than 20 employees. This survey does not contain the exact number of employees of each firm. Therefore, all firms with less than 20 employees are defined as micro enterprises.

[17] The IMK-survey 2013 was conducted by the BPS.

1.3 Regional development policies in Indonesia

Over the last two decades, Indonesia experienced substantial and still ongoing socio-economic and political changes. After the shock of the Asian financial crises 1997/98 and the ending of Soeharto′s dictatorship in 1998, Indonesia turned into a democracy (FIRMAN, 2009). Nowadays, Indonesia belongs to one of the most decentralized countries in the world. The country consists of 34 provinces, 511 regencies, and cities as well as about 72,000 villages (SANDEE, 2016). This division in many administration units happened under the program 'regional autonomy': The regencies and municipalities are now responsible for education, drafting regulations on local business permits and have got fiscal authority (ASTIYAH et al., 2011; LEWIS, 2016). It was expected that this reform with local leaders as a new group of stakeholders would lead to a better performance of local communities as well as improve the region′s economic welfare. The hope was that with a stronger influence of local leaders, economic growth could be further accelerated, as, by being aware of local competitive advantages, local stakeholders could help to establish regional industries that could compete on the national or even global level (ASTIYAH et al., 2011).

Generally, the decentralization yielded to decrease the primacy of Java and the urban-rural disparities (SAROSA, 2006). However, regional economic disparities remain high, particularly between the western (e.g., Java and Sumatra) and the eastern (e.g., Papua and Maluku) islands (ASTIYAH et al., 2011). Java still contributes to more than half of the national GDP. From 2011 to 2016, the contribution even increased from 56.6 % to 58.5 %. The contribution of the provinces in Papua and on the Maluku slightly increased from 2.4 % (2011) to 2.5 % (2016)[18].

With regard to the regional development in urban areas, a World Bank study (2012) identified three phenomena of regional development in Indonesia. First, many metropolitan areas gradually de-concentrate, and the economic growth more and more takes place in the peripheries. Second, the industry is increasingly located in the periphery area. Third, the urban expansion includes multiple political jurisdictions that oftentimes have conflicting interests.

In addition, the decentralization has also led to cognitive challenges because the local authorities had to take over additional responsibilities and roles but possessed inadequate financial and human resources and lacked experience (CHANG SENG, 2013). As a result, the radical decentralization has led in the metropolitan areas to institutional fragmentation and on the regional level to strong institutional arrangements (HUDALAH et al., 2014). Consequently, due to 'local

[18] Own calculation based on BPS Indonesia (2017a).

egoism', coordinated regional development has become more difficult (FIRMAN, 2009; LIPSEY & SJÖHOLM, 2011).

The decentralization policy also determines the disaster management (DM) policy[19] in Indonesia. As a consequence of the Boxing Day Tsunami 2004 and the earthquake in Yogyakarta 2006, Indonesia reformed its DM policy (DAS & LUTHFI, 2017; DJALANTE et al., 2017). Pushed by the adoption of the Hyogo Framework for Action in 2005, institutional and regulatory guidelines were reformed, accentuated especially by the passing of law No. 24/2007[20] on disaster management and the establishment of national and local disaster management agencies (BNPB and BPBDs). BNPB replaced the Bakornas PB secretariat, and the BPBDs replaced the Satkorlak PBA (provincial level) and the Satlak PBA (district level) since they accomplished sparse progress on disaster risk reduction (DRR)[21] (DJALANTE et al., 2017; LASSA, 2013). The new agencies share the responsibility on DRM policy as well as received technical and financial resources to develop and implement DRR-strategies such as a hazard early warning system (BNPB, 2015; DAS & LUTHFI, 2017). In 2015, 90 % of all districts or cities established a BPBD. Although all provincial BPBDs developed a provincial disaster management plan in 2012, only 15 % of the local BPBDs have produced a plan for the respective district or city (BAPPENAS, 2015).

Against the background of the decentralization policy, different levels of governmental authorities (national, regional, and local) are responsible for the DRR and DRM (LASSA, 2013). Although the BPBD is assigned as the coordinator to implement DRM policies, it has to arrange its DRM policy plans with numerous ministries (e.g., the Ministry of Public Works and Housing, the Ministry of Home Affairs and the Ministry of National Development Planning) as well as with the BPBDs. (MARDIAH et al., 2017). This coordination still lacks clarity regarding the distribution of tasks (DAS & LUTHFI, 2017). Furthermore, the demands of the stakeholders have to be respected. Therefore, the BNPB and the provincial BPBDs are encouraged to organize DRR platforms that facilitate the coordination of DRR efforts among different political authorities, the civil society, NGOs, and the private sector (DJALANTE et al., 2017; LASSA, 2013; UNISDR, 2007).

[19] The UNISDR (2006:14) defines DM as "[t]he organization, planning and application of measures preparing for, responding to and recovering from disasters."

[20] For further information, please see Government of Indonesia (2007).

[21] According to the UNISDR (2016:16) DRR aims "at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development."

Overall, the paradigm shift of the disaster management policy has led to an improved, more comprehensive approach in recent years. Due to the implementation of the new law and the BNPB as well as the BPBDs, primarily institutional and technological capacities have been strengthened (DJALANTE & GARSCHAGEN, 2017; MARDIAH et al., 2017). However, regarding the DRM policy, Indonesia′s decentralization leads to shortcomings of clarities on the coordination of the responsibilities and financial funding at the sub-national level (DAS & LUTHFI, 2017). Due to the ongoing urbanization, Indonesia has to emphasize more on urban disaster risk reduction by better infrastructure development, more emphasis on reduction of the urban poverty, more effective law enforcement, and a more inclusive cooperation with the communities, but also with the private sector (DJALANTE & GARSCHAGEN, 2017; REMBETH, 2015; WORLD BANK, 2014b).

Concerning the emphasis on firms in this thesis, the question can be raised how the private sector (i.e., firms) is involved in Indonesia′s DM policy, so far. Formally, the contribution and responsibilities of firms are mentioned in the disaster management law (24/2007). According to article 16, paragraph 3 (law 24/2007) preparedness activities shall be the responsibility of the national and regional government, but the implementation should be jointly undertaken with the communities and business institutions[22] (GOVERNMENT OF INDONESIA, 2007). Moreover, business institutions are encouraged to implement DM plans regularly on their own and in cooperation with other institutions (article 28 law 24/2007). Their activities should be aligned with the national and regional DM policy, be published publicly and submitted to the BPBDs. Furthermore, business institutions are obliged to support the governmental disaster management policy as a form of corporate social responsibility (article 29) (GOVERNMENT OF INDONESIA, 2007).

There are also some initiatives where the firms play a crucial role in disaster management. Within the Disaster Resource Partnership that has been launched in 2011 national private and state-owned engineering and construction companies support the capacity building of the national DM policy (REMBETH, 2015). For instance, the network supported the disaster relief after the earthquake in Central Aceh 2013 and the flash flood 2014 in Manado. Furthermore, the network is involved in preparedness activities, such as seminars, as well as humanitarian and mitigation assessment programs (REMBETH, 2015). Telkomsel, Indonesia′s largest mobile

[22] The law 24/2007 defines business institutions as any legal institutions that may be state-owned enterprises, regional-owned enterprises, cooperatives, or private enterprises domicile within the territory of the Republic of Indonesia (GOVERNMENT OF INDONESIA, 2007).

phone network operator, engaged in response and recovery operations during the massive floods in Jakarta in 2013. Their activities were exercised by the established TERRA-team (Telkomsel Recovery Emergency Response Activity). This team with 300 members is trained on special response and recovery actions. Branch offices are equipped with boats, generators, and tents in order to repair the communication network, support the evacuation of victims, and distribute relief commodities. Telkomsel also provides free telecommunication services during and after flooding (BURKE & FAN, 2014). These examples show that primarily large firms are engaged in disaster risk reduction.

1.4 Research objectives and structure of the thesis

The mentioned connection between natural hazards and the ongoing political as well as economic change make Indonesia a relevant case to examine how firms make decisions on adaptation when faced with dynamically changing risk profiles, and how regional development is shaped by the firms′ individual and collective adaptation action. Against this background, especially, coastal cities, such as Jakarta and Semarang with a substantial concentration of manufacturing firms provide meaningful case study regions.

Until now, various disciplines provide empirical studies and conceptual ideas that more or less address the role of firms and their impact on changing regional trajectories. Relevant strands are, therefore, briefly outlined in order to elaborate the aimed contribution of this thesis.

First, numerous papers estimate the damages and losses caused by flood events that firms have to face. This research has a long history and emerged prominently by the quantitative study of Tierney (1997) on the business interruptions of 1,000 firms after the Northridge earthquake 1994. Furthermore, Haraguchi & Lall (2015) present the direct and indirect economic impacts after the Thai floods 2011 on multinational firms in the automotive and electronics sector and outline the supply chain disruptions. Kreibich et al. (2007) discuss the preparedness and precaution measures of firms in the context of floods in Saxony, Germany 2002. Also, research deals with the recovery time and/or survival rate of firms (e.g., BAHINIPATI et al., 2017; MEL et al., 2012; SYDNOR et al., 2017). Overall, the studies show that firms oftentimes bear a high amount of economic losses due to disaster events (e.g., droughts, earthquakes, or floods) and that firms have a high need to respond immediately to natural hazards (IRP, 2016; WILBANKS et al., 2007). Existing literature deals particularly with disaster events, but recurrent and aggravating flood risk are less researched.

Second, the literature emphasizes the role of firms in supporting political authorities and the community in (flood) risk reduction (e.g., IZUMI & SHAW, 2015; MCKNIGHT & LINNENLUECKE, 2016; PAUW, 2015). This strand can be subsumed under the term 'private-sector engagement.' Predominately, publications from NGOs, political think tanks, and international aid organizations outline best practice examples or propose guidelines to accelerate the engagement of the private sector on DRR (e.g., AGRAWALA et al., 2011; IRP, 2016). Within this discourse, it is argued that investments in risk reduction can be a profitable business opportunity for firms. For instance, firms can develop innovative products or strengthen ties with governmental authorities (e.g., GAO & HAFSI, 2017; IZUMI & SHAW, 2015). It is also discussed whether and if so under which conditions firms show a philanthropic response to natural hazards (SARMIENTO et al., 2015; TILCSIK & MARQUIS, 2013). Regarding firms′ engagement in DRR, studies show that particularly large firms are involved in disaster relief. They respond to disaster events with corporate philanthropy (e.g., donations or flood supply). However, long-term engagement in adaptation is oftentimes lacking (JOHNSON et al., 2011; MCKNIGHT & LINNENLUECKE, 2016). It is also suggested that firms are the driving force of communities′ effective recovery after disaster events. Consequently, the failure of firms′ adaptation activities might also negatively influence social welfare (IRP, 2016).

Third, conceptual ideas of business adaptation or organizational resilience are often developed within the organization and business studies (e.g., BUSCH, 2011; LINNENLUECKE & GRIFFITHS, 2015; WEICK & SUTCLIFFE, 2001). This body of research relies on the 'resource-based view' (cf. BARNEY, 1991), the idea of 'routines' (cf. NELSON & WINTER, 1982), 'dynamic capabilities' (cf. EISENHARDT & MARTIN, 2000; TEECE et al., 1997), and organizational learning (cf. LEVITT & MARCH, 1988) in order to elaborate which capabilities of organizations enable them to adapt to sudden or gradual changes in the organizations′ environment (WEICK & SUTCLIFFE, 2001). Lately, these conceptual considerations have been aligned to studies on organizational adaptation mostly to climate change impacts and weather extremes (e.g., BERKHOUT et al., 2006; LINNENLUECKE & GRIFFITHS, 2015).

Fourth, particularly governance approaches emphasize the idea of community-based adaptation or adaptive governance where all affected stakeholders (e.g., state authorities, firms, civil society, and residents) collaborate in order to achieve adaptation to natural hazards (e.g., ARCHER et al., 2014; BERKES & ROSS, 2013). The idea of 'adaptive governance' emphasizes that governance is characterized by polycentric and multi-layered institutions, participative and collaborative relationships, self-organization and networks (DJALANTE et al., 2011; FOLKE et al.,

2005; PAHL-WOSTL et al., 2013). The effectiveness and legitimacy of risk governance depend on the success of the collaborative actions by the multiple stakeholders to resolve complexity and uncertainty (RENN & KLINKE, 2013). With a particular focus on the complexities of urban centers, the term 'adaptive urban governance' argues that governance requires the consideration of the interrelationship between formal (e.g., laws and regulations) and informal institutions (e.g., customs, social capital). Therefore, effective adaptation needs structural measures (e.g., flood protection systems) as well as the integration and, if possible, the modifications or transformations of multi-level governance structures and disaster management planning systems (BIRKMANN et al., 2010).

Fifth, behavioral economics approaches have been so far sparsely addressed in the context of adaptation to natural hazards. Existing research addresses, for instance, the risk behavior after disaster events (e.g., CAMERON & SHAH, 2015), and laboratory studies are conducted, for instances, on the tradeoff between mitigation of greenhouse gasses and adaptation to climate change (HASSON et al., 2010). Willingness to pay-approaches are more elaborated in the context of flood mitigation strategies (e.g., purchase of flood insurance schemes), but predominately apply to residents and communities (ABBAS et al., 2015; BOTZEN et al., 2013).

Sixth, concerning the interplay of adaptation and regional development, evolutionary economic geography approaches focus on the understanding of how co-evolutionary change can happen (BOSCHMA & FRENKEN, 2011). This research interest is particularly inspired by the idea of 'routines' (cf. NELSON & WINTER, 1982), 'path creation' (cf. GARUD & KARNØE, 2001) and the 'ecological resilience' approach (e.g., HOLLING, 1973). For instance, the idea of 'regional economic resilience' (MARTIN & SUNLEY, 2015) emerged in the last decade. This approach investigates the ability of regional trajectories to recover from or withstand market, structural, or environmental shocks or, if necessary, to create a new growth path through adaptive changes of regional economic structures as well as social and institutional structures (MARTIN & SUNLEY, 2015). Although natural hazards are considered within the discourse of regional economic resilience, empirical studies mostly deal with structural crises or economic shocks.

In sum, there are various approaches that address firms′ exposure and adaptation to floods, consider the impact of shocks or natural hazards on regional trajectories as well as utilize behavioral economic approaches. However, the research remains short on a comprehensive understanding of firms′ development of adaptation strategies and firms′ abilities to foster risk reduction in their neighborhood (e.g., residents, workers, critical infrastructure). The aim of this

dissertation is, therefore, to complement the literature on adaptation to natural hazards in developing countries and emerging economies with a better conceptual and empirical understanding on firms′ dual role in individual and collective adaptation and to detect which outcomes might lead to a change of the regional trajectory. In this context, the thesis seeks to elaborate firms′ rationales regarding their individual flood adaptation strategies and to provide a novel methodological approach in order to estimate firms′ engagement in collective flood risk reduction measures.

Against this background, the research questions are specified as follows:

Theory:

RQ1: Which valuable insights do different literature strands provide in order to conceptualize a more comprehensive analytical framework on firms′ activities to adapt to environmental hazards?

RQ2: Which firms′ resources and competencies determine the development of effective flood adaptation strategies?

Methodological approach:

RQ3: How can methodological approaches originate from behavioral economics be applied in order to understand the rationales and contextual factors of firms′ willingness to contribute to collective flood risk reduction?

Empirical results:

RQ4: To what extent do floods affect manufacturing firms?

RQ5: How do firms develop individual flood adaptation strategies? Are firms willing to contribute to a collective adaptation measure?

RQ6: Does the firms′ engagement in individual and collective adaptation differ between different sizes of business and between locations?

RQ7: To what extent are firms able to drive changes of regional trajectories towards a more integrative adaptive regional development?

Policy-guided:

RQ8: How might manufacturing firms support flood risk reduction management within a governance system?

RQ9: Which political designs are needed to foster larger firms′ engagement towards an integrative adaptive regional development?

The thesis is structured as follows: Chapter 2 introduces the research design. The case study regions Jakarta and Semarang are presented with a particular focus on the role of manufacturing firms in these two cities. Furthermore, the characteristic exposures to floods are outlined. Besides, the data is presented, and the applied methods are elaborated. Chapter 3 provides the conceptual framework of the thesis. Chapter 4 describes in an overview how firms are affected by floods and which adaptation actions are pursued. Moreover, I discuss whether firms and state authorities join forces on a more effectively coordinated strategy to reduce flood risks. A more detailed perspective on firms′ individual flood adaptation strategies is demonstrated in Chapter 5. The chapter conceptualizes and empirically applies a typology of different firms′ flood adaptation strategies. Chapter 6 investigates the willingness of MSMEs to contribute to collective flood adaptation measures. A novel empirical approach, the scenario-based field experiment, is presented and empirically applied. Finally, Chapter 7 concludes the dissertation. A cohesive discussion of the empirical and theoretical contribution is elaborated. Furthermore, the limitations of the research and policy implications are outlined.

2 Research design

2.1 Research areas

As outlined in Chapter 1, manufacturing firms are to a great extent confronted with flood risks in coastal cities. Hence, the coastal cities Jakarta and Semarang were chosen mainly for two reasons: their economic importance for Indonesia or the particular province and their high exposure to floods.

First, both cities have considerable economic importance for the country (Jakarta) or for the region (Semarang). The Indonesian capital Jakarta is the economic driving force of the national economy (HUDALAH & FIRMAN, 2012). Regarding the economic dynamic of the entire economy, it can be stated that the GDP of Jakarta (5.9 %) and Semarang (5.5 %) grew faster than the national average (5.3 %) between 2001 and 2016. Due to the international financial crises, the entire Indonesian economy suffered lower growth rates in 2009. The manufacturing sector in entire Indonesia (4.6 %), in Jakarta (4.1 %) and Semarang (4.5 %) grew slower than the entire economy between 2001 and 2016. Between 2002 and 2004 as well as in 2011 the growth rate of the manufacturing sector in Indonesia outperformed the growth rate of the entire GDP. The growth rate of the manufacturing sector in Jakarta never exceeded the growth rate of the total GDP in the selected time period. The growth rate of the manufacturing sector in Semarang outperformed in 2007, 2013 and 2014 (cf. Figure 2-1).

The manufacturing sector was with 13.8 % the second-largest contributor to the GDP (2015) of Jakarta. The industrial sub-sectors transport equipment, chemicals, and pharmaceuticals, and metal products are the main contributors to the regional GDP of Jakarta. 5.1 % (1,200 firms) of all manufacturing firms with more than 20 employees in Indonesia are located in Jakarta. Manufacturing firms are mainly located in the coastal area of Jakarta and along the toll roads. The Northwestern sub-districts Penjaringan, Kali Deres, Tambora and Cengkareng have the highest densities of manufacturing firms. A high density of manufacturing firms can also be detected in the Northeastern sub-districts Cakung und Cilincing (cf. Figure 2-2). In the entire metropolitan area of Jabodetabek 20.8 % (4,891 firms) of all manufacturing firms of Indonesia is located.[23]

[23] Own calculation based on BPS Indonesia (2015a)

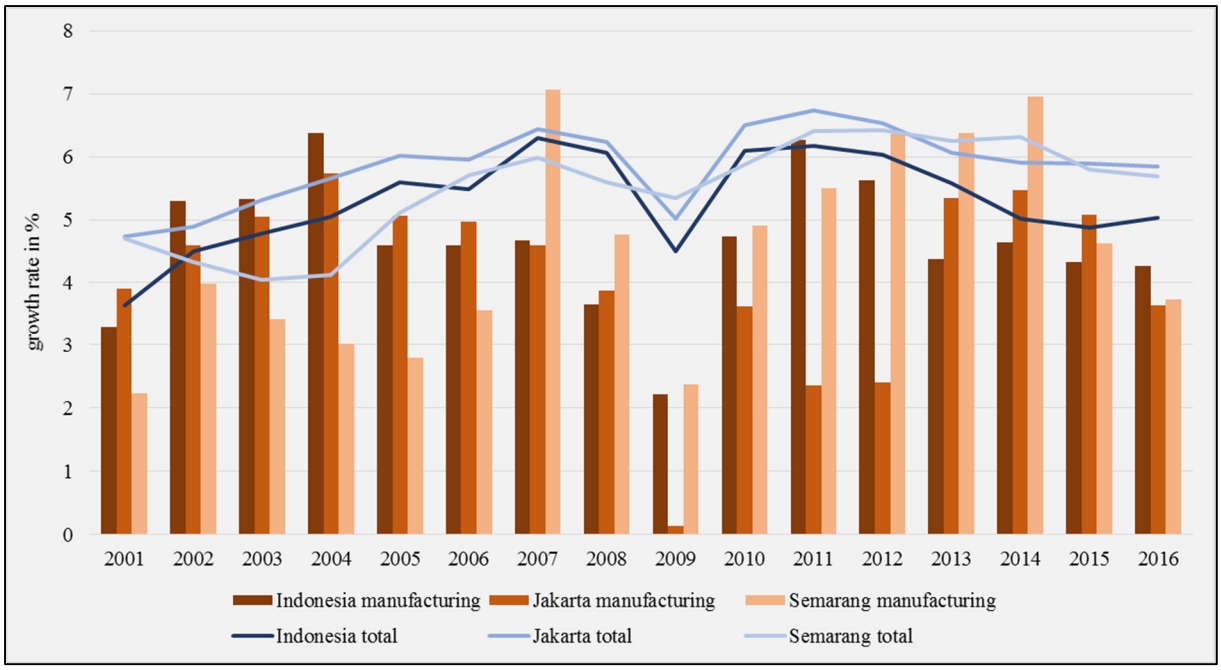


Figure 2-1: Growth rate of GDP and manufacturing sector in Indonesia, Jakarta, and Semarang between 2001and 2016 (Data: own calculation based on BPS DKI JAKARTA, 2006; 2009; 2012; 2017; BPS JAWA TENGAH, 2002; 2007; 2010; 2017b; BPS INDONESIA, 2004; 2007; 2017e; 2015b; 2017a; BPS KOTA SEMARANG, 2014)

Semarang, the capital of the province Central Java and the fifth largest Indonesian city, is located at the Northern coast of the Java Sea. The city is the political as well as the industrial center of the province. The manufacturing sector is the most dominant one and contributes 27.6 % to the regional GDP. The food industry, production of textiles, and wearing apparels as well as the chemical and pharmaceuticals are the main contributors to the regional GDP (BPS JAWA TENGAH, 2017b). Regarding the location of manufacturing firms nationwide, Semarang does not play an important role: Only 1.3 % (311 firms) of all manufacturing firms with at least 20 employees are located in Semarang. However, in Central Java, the city has the highest share of manufacturing firms of all districts (8.6 % = 311 firms), although Central Java has many regional important industrial cities (e.g., Jepara, Klaten, and Pekalongan). Particularly the harbor of Semarang plays a crucial role for the surrounding districts. Tanjung Mas is the chosen harbor for more than 80 % of all exports of Central Java (BPS Jawa Tengah, 2017a). Due to the good connectivity through (toll) roads, many firms lie in the vicinity of the city of Semarang. Together with its surrounding districts (Demak, Grobogan, Kendal, Salatiga, and Semarang)[24] the metropolitan region of Semarang stands for 17.7 % (644 firms) of all manufacturing firms located in Central Java. In the municipality of Semarang, the highest density of manufacturing

[24] The National Planning and Development Agency (BAPPENAS) combines these cities and districts to the metropolitan area Kedungsepur (GOVERNMENT OF INDONESIA, 2017).

firms can be observed in the Northern coastal sub-districts. Notably, the Eastern coastal sub-district Genuk shows the highest density of manufacturing firms which is also evident in absolute numbers (82 firms).[25] However, the number of firms has been reduced by about one quarter between 2001 and 2015. In Semarang Utara, the number of firms decreased by half. A high number of manufacturing firms is also located in the Western sub-districts Ngaliyan (44 firms) and Tugu (42 firms)[26] (cf. Figure 2-2).

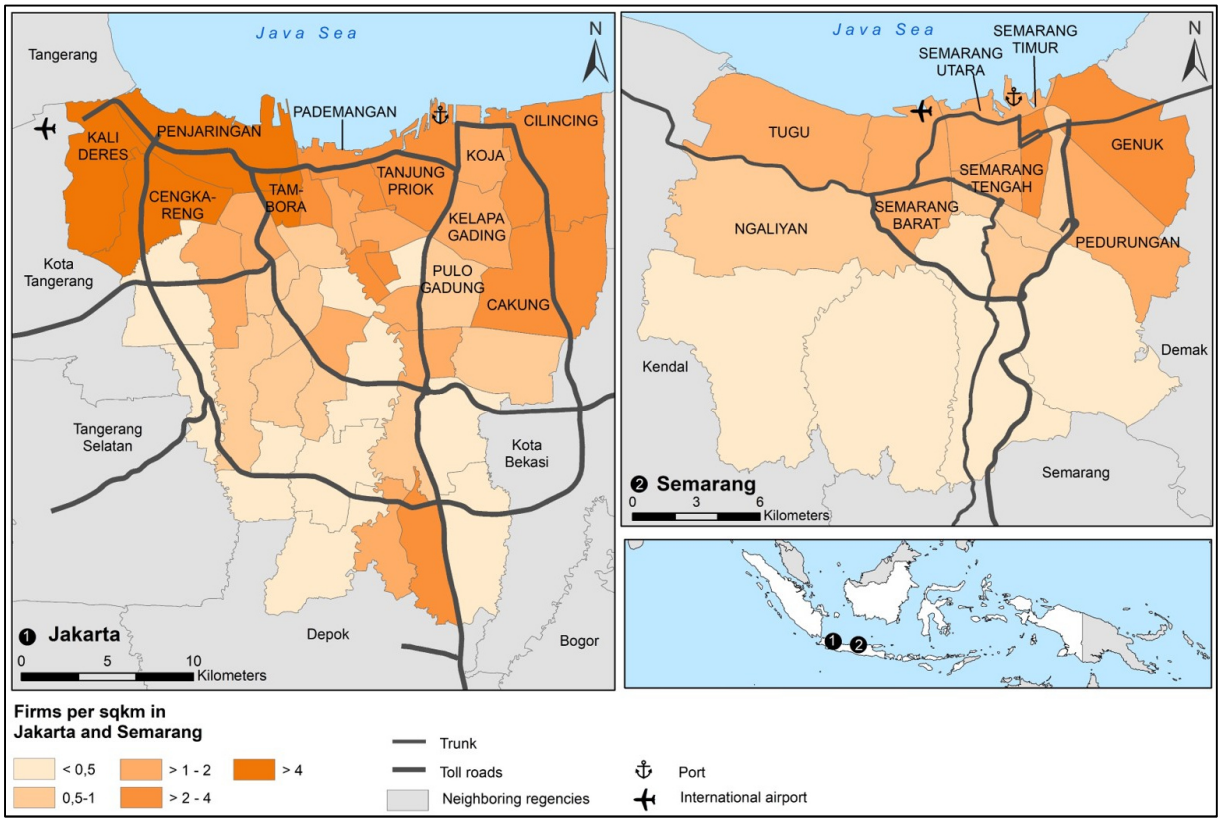


Figure 2-2: Density of manufacturing firms in Jakarta and Semarang (Source: BPS INDONESIA, 2015a; Design: Thomas Neise and Lena Krist)

Second, high exposure to floods makes both cities interesting case study regions. An increase in population and land use change puts the inhabitants and firms in both cities under pressure (FIRMAN, 2009). Although Jakarta faces floods since the Dutch colonial era, urban expansion, reduction of mangroves and deforestation in the mountainous hinterland as well as narrowed river arms have made floods a more pressing natural hazard (FIRMAN et al., 2011; VAN'T KLOOSTER et al., 2012). Two kinds of floods expose Jakarta and consequently, the manufacturing firms located in this city: The coastal area is mainly affected by tidal inundation because

[25] Own calculation based on BPS Indonesia (2015a)
[26] Own calculation based on BPS Indonesia (2001; 2015a)

large parts are below the sea-level. Land subsidence (per average 4 cm per year) further exacerbates the risks, especially at locations where it reaches maximum rates up to 20 to 28 cm annually (ABIDIN et al., 2011). Fluvial floods (i.e., riverine inundation) frequently occur during the monsoon season (November – March) nearby the thirteen rivers and the myriads of canals that are oftentimes clogged by garbage. Pluvial floods (i.e., surface inundation) happen especially in the rainy season due to clogged waterways, vanished catchment areas and sealed land that reduces the rainwater absorption (FIRMAN et al., 2011; SAGALA et al.; STEINBERG, 2007). Severe flooding has roughly occurred once every five years (e.g., 2002 and 2007), but recently large-scale inundations occur more frequently, for instance in 2013 and 2014. Furthermore, the city faces minor floods several times per year (JAKSAFE, 2018; PETERS et al., 2015; SAGALA et al.; TEXIER, 2008).

Over a long time, city authorities in Jakarta did not respond sufficiently to the flood risks and the causing factors such as rapid, unplanned urbanization and the reduction of floodwater discharge instruments (FIRMAN et al., 2011; WORLD BANK, 2012). Although the East and West Flood canals (*Banjir Canal Timur and Banjir Canal Barat*) were constructed after a delay of 33 years, the city authorities are still overburdened with the flooding and have shown since then a lethargic behavior (SIMANJUNTAK et al., 2012). However, for about one decade increasing activism on flood mitigation measures can be observed. Namely two main events can be seen as decisive: First, the political paralysis has been reduced since the governorship Joko Widodo (2012-2014) and his successor Governor Basuki Tjahaja Purnama (2014-2017). Second, massive floods in 2007 and 2012 have resulted in an intensification and reorientation of flood mitigation measures (GARSCHAGEN & SURTIARI, 2018; SAGALA et al., 2018). The government is now more focused on a dialogue with the civil society, sensitizing the inhabitants about the prevention of floods; and the 'orange and blue rangers'[27] clean the waterways (SAGALA et al., 2018; VAN VOORST, 2016). The local disaster management agency (BPBD) has been enhanced. For instance, more sophisticated flood forecast and assessment systems have been implemented (PADAWANGI, 2014; VAN VOORST, 2016). Along with international aid by the World Bank, the Netherlands and the JICA (Japan International Cooperation Agency), the JEDI-Project (Jakarta Emergency Dredging Initiative) has been launched. Since 2013, eleven waterways with a total length of 67.5 km and four retention basins are dredged and restored (WORLD BANK, 2014a).

[27] Under the former governor Basuki Tjahaja Purnama the solid waste management agency hired up to 20,000 orange and blue rangers. The orange rangers are deployed to clean up the garbage from the rivers. The blue ranger are taking care of the water flow (SAGALA et al., 2018).

Currently, the majority of the construction has been completed. However, due to the lack of further national funding and the unreliability of one of the three executing agency, the finalization has been delayed since 2015 (Personal interview with representative of Jakarta Public Works Agency, 2017).

Nevertheless, floods have not vanished, and the flood mitigation strategies are far from optimum. For instance, the downstream of rainwater from the Southern highlands often overload the water discharge capacities in Jakarta. Therefore, according to FIRMAN et al. (2011) flood levees and retention ponds should be built in the Southern hinterland of Jakarta. However, river management is still not sufficiently coordinated with the neighboring authorities of Bogor and Depok (FIRMAN et al., 2011).

Furthermore, the ongoing land subsidence has not been stopped and remains still a big challenge. Without solving this issue, the efficacy of the JEDI-project and other soft activities (e.g., cleaning the waterways) will be limited. With regards to the primarily industrialized parts in the Eastern and Western coastal area, it is evident that state interventions just slightly address the flood risk. Concerning the largest industrial area in the East nearby the harbor, the flood risks will be probable increasing as heavy buildings are under construction. As the urban surface load will further increase, this will probably also increase the high land subsidence rate.

In sum, Jakarta still requires more engagement in flood mitigation, but the limited financial and human resources currently barely allow further acceleration of flood mitigation measures. Hence, private funding, for instance from manufacturing firms, might foster the engagement in flood mitigation, particularly in primarily industrialized flood-prone areas.

Similarly, for about one decade Semarang is expanding rapidly. Former green sensitive coastal areas have been converted into commercial, residential and industrial areas. The majority of industrial and commercial areas is still located on low lying coastal floodplains with a maximum elevation of 10m. But, further city expansion is taking place at the uplands in the Southern part of the city. As the remaining mangroves in the western part of the city are vanishing and most parts of the lowland are affected by land subsidence, the risk of particular tidal inundation is accelerating. Moreover, the rate of land subsidence is increasing. During 2008 and 2011, the land subsidence average was 7 cm per year, up to 14-19cm/year at some spots. Particularly the highly populated northern part at the coast shows high rates of land subsidence and flooding caused by a natural compaction of the young alluvium soil, which is strongly enhanced by extensive urbanization and excessive groundwater extraction (HARWITASARI & VAN AST, 2011; LUBIS et al., 2011; MARFAI & KING, 2007; 2008). Calculations by Marfai & King (2007) point

out that in 2020 27.5 ha on the coastal area will be up to 2 meters below sea-level. Increasing land subsidence will also lead to more affected areas by tidal flooding.

Besides the risk of tidal inundation, pluvial and fluvial flooding frequently occurs as the settlements are lying lower than the waterways. Tidal inundation also occurs more frequently and lasts longer. Generally, the mostly low-level inundation is not threatening human lives or firms′ viability, but it is rather a frequent disruption that might result in firms′ closure in the long-run. For instance, the salty sea water damages buildings and critical infrastructure (HARWITASARI & VAN AST, 2011; LUBIS et al., 2011). However, land subsidence and coastal erosion are continuing, and my own field observation indicates that, for instance, in the western part of the city, parts of the former agriculture and industrial land are vanishing permanently and becoming uninhabitable.

In order to address the flood risk, the two main rivers of Semarang are designated as flood canals. The Western Flood Canal (*Banjir Canal Barat*) has been widened by the Semarang municipality with financial support from JICA and has been finished in 2013 (WIDYANTI et al., 2014). However, its efficacy is limited to an area of just about 500 m away from the flood canal. Factories, storages, and public buildings nearby are often affected by floods because a water drainage system that leads the rainwater flows into the flood canal is lacking. The Eastern Flood Canal (*Banjir Canal Timur*) has a very limited catchment capacity because informal riverbank settlements and mud have narrowed the course of the river and thereby the catchment capacity. Currently, the city authorities aim to rebuild the flood canal, but the problems of funding and the relocation of the settlement are not solved yet (SETYOADI, 2017). Additionally, the city of Semarang has constructed dikes at two smaller rivers to prevent seawater from flowing into the rivers during high tides. At the coast, water ponds were constructed so that the river mouths are now designed as polders (KOTA SEMARANG, 2016). Next to the central train station in the city center, the water pond capacity has been increased during the revitalization program of the old town (WAHYUDI et al., 2017). In general, the protection measures against pluvial and fluvial floods have been accelerated, and the flood risks could be decreased. However, land subsidence is still a big challenge, especially at the harbor area and in the largest industrial area Genuk in the western part of the city, and still oftentimes causes tidal inundation.

2.2 Data & methodology

Overall, the empirical research was conducted in line with a case study approach (cf. YIN, 2014) in order to compare two cities and to detect differences or similarities between firms with regard to their business size. The research findings originate on multiple levels of empirical analyses. In a first step, suitable case study locations were selected. The selection of flood-prone sub-districts with a substantial number of manufacturing firms in Jakarta and Semarang served as a basis for the subsequent field research. In a second step, qualitative data material was collected from 67 in-depth interviews with decision-makers of manufacturing firms and 31 expert interviews with numerous stakeholders (e.g., political authorities, NGOs and scientists). In a third step, quantitative data was gathered from 120 scenario-based field experiments that consisted of an experiment and a brief survey.

The empirical research was conducted during five field trips. During the first field trip between March and April 2015, I conducted the first expert interviews and presented the preliminary analytical framework IARD (cf. Chapter 3) at the second TWIN-SEA workshop in Jakarta. Besides, appropriate local case study regions in Jakarta were visited. From August until October 2015, the in-depth interviews were conducted and appropriate local case study regions in Semarang were visited. I continued with the in-depth interviews on a third field trip from March until May 2016 in Semarang. At the fourth field trip (September – November 2016) the 120 scenario-based field experiments were completed, and 10 additional in-depth interviews with MSMEs were conducted. During the fifth field trip (March – April 2017), I interviewed more politicians and presented the results of my scenario-based field experiments during the fourth TWIN-SEA workshop.

2.3 Methodological approaches

2.3.1 Case-study selection

For the selection of suitable local case study regions, two main criteria were defined: First, the region should be characterized by high flood risk. Therefore, official data from the BNPB about flood events and future flood risk and news articles about flooding in Jakarta and Semarang were analyzed in desk research. The second criterion was that the case study areas should have a high number of manufacturing firms at a flood-risk location. The coastal cities Jakarta and Semarang met the required research objectives to a high degree (cf. Section 2.1). The selection of both cities proved to be well chosen during interviews in Jakarta with scientists, political authorities, and NGOs at the second TWIN-SEA scientific workshop 2015. Furthermore, flood-

prone areas in Jakarta and Semarang were visited, and local stakeholders were interviewed (e.g., local NGOs, district leaders, small business owner). This information was incorporated into the detailed selection of sub-districts in Jakarta and Semarang which served as an organizational base for the in-depth semi-structured interviews and scenario-based field experiments (cf. Section 2.3.2 and 2.3.3). The density of manufacturing firms at the sub-district level was extracted from the directory of medium-sized and large manufacturing firms 2015 (BPS INDONESIA, 2015a) and the Village Potential Statistics (PODES) 2014 provided the number of small firms (BPS INDONESIA, 2015c); both results were mapped. Local flood-prone areas were collected from data of the PODES which contains the number of pluvial and fluvial flood events between 2011 and 2013 on the sub-district level. Since tidal floods are a major concern in Semarang, a prediction for the year 2050 of permanently inundated areas (cf. PRUß & REVILLA DIEZ, 2016) was also taking into consideration. Table 2-1 lists the selected local case-study regions.

Table 2-1: Selected case study regions in Jakarta and Semarang

City	Regency	Sub-District
Jakarta	North Jakarta	Cilincing Koja Penjaringan Tanjung Priok
	West Jakarta	Cengkareng Kali Deres Kebon Jeruk
	East Jakarta	Cakung
	South Jakarta	Mampang Prapatan
Semarang	Municipality Semarang	Genuk Semarang Barat Semarang Tengah Semarang Timur Semarang Utara Tugu

Source: Author′s analysis

2.3.2 In-depth and expert interviews

In order to answer the research questions how firms are directly and indirectly exposed to flood events (RQ4), which adaptation actions they are pursuing (RQ5) and whether the firms′ flood adaptation strategies differ regarding the business size (RQ6), a qualitative approach was applied. The purpose of the in-depth interviews was to understand the rationales of the firms′ decision-maker on their adaptation strategies and to collect detailed information on how the firms are exposed to floods. The collected information was compared in the analytical step in

order to identify similarities and difference between the sample (PRZYBORSKI & WOHLRAB-SAHR, 2014).

Therefore, the empirical investigation was based on 67 in-depth semi-structured interviews with representatives (e.g., business owner, directors) from manufacturing firms[28]. The in-depth interviews aimed to provide a detailed understanding of the disruption of firms′ business processes caused by floods and the determinants of firms′ rationales to implement adaptation measures or the inability to do so. Based on these outcomes, potential outcomes of firms′ engagement on regional trajectories could be derived. In order to detect similarities and differences in firms′ adaptation measures, a broad spectrum of firms in different business sectors and with different business sizes was selected. Both case study regions allowed to examine the influence of different regional governance systems (MARTIN & SUNLEY, 2015).

The interviews took place during two field trips. The interviews in Jakarta were conducted between August and October 2015. In Semarang, the interviews took place between March and May 2016[29]. In Jakarta, 33 interviews with firms have been conducted and in Semarang 34 interviews. Figure *2-3* displays the location of the interviewed firms.

The selection of the firms was based on purposive sampling. SMEs and large companies were selected differently. SMEs were identified by the address given in the 'Manufacturing Industry Directory 2015' (BPS INDONESIA, 2015a). In the prior selected sub-districts (cf. Section 2.3.1) neighborhoods[30] with a high number of SMEs were chosen. Within the neighborhood, firms were selected randomly[31]. Before starting the interviews, the owners or the security guards were asked whether the firm had experienced flooding in the last ten years. The selection of large companies was also based on the 'Manufacturing Industry Directory 2015' (BPS INDONESIA, 2015a). Due to the low number of large firms, all firms within an apparently flood-prone sub-district were contacted via telephone and/or request letter. The firms were also asked beforehand, whether they had experienced flooding in the last ten years.

[28] Annex A provides a full list of all interviewees (cf. Table A-1).

[29] Since MSMEs were underrepresented in the sample, 10 additional in-depth interviews were conducted between September and November 2016.

[30] The neighborhoods (*kampungs*) were classified according their street names. Streets in a *kampung* usually named similar and are only differentiated by consecutive numbers and/or compass direction. For instance, the main street was 'Jalan Kalibaru' (Kalibaru street) and one site streets is called 'Jalan Kalibaru Timur I' (First East Kalibaru street) and so on.

[31] Looking for randomly selected firms based on the given address and name in the directory was hardly feasible. The addresses were sometimes incomplete (e.g. house number was missing) or the name had been changed. Nonetheless, the directory provided valuable information on clustered SMEs in the case-study regions.

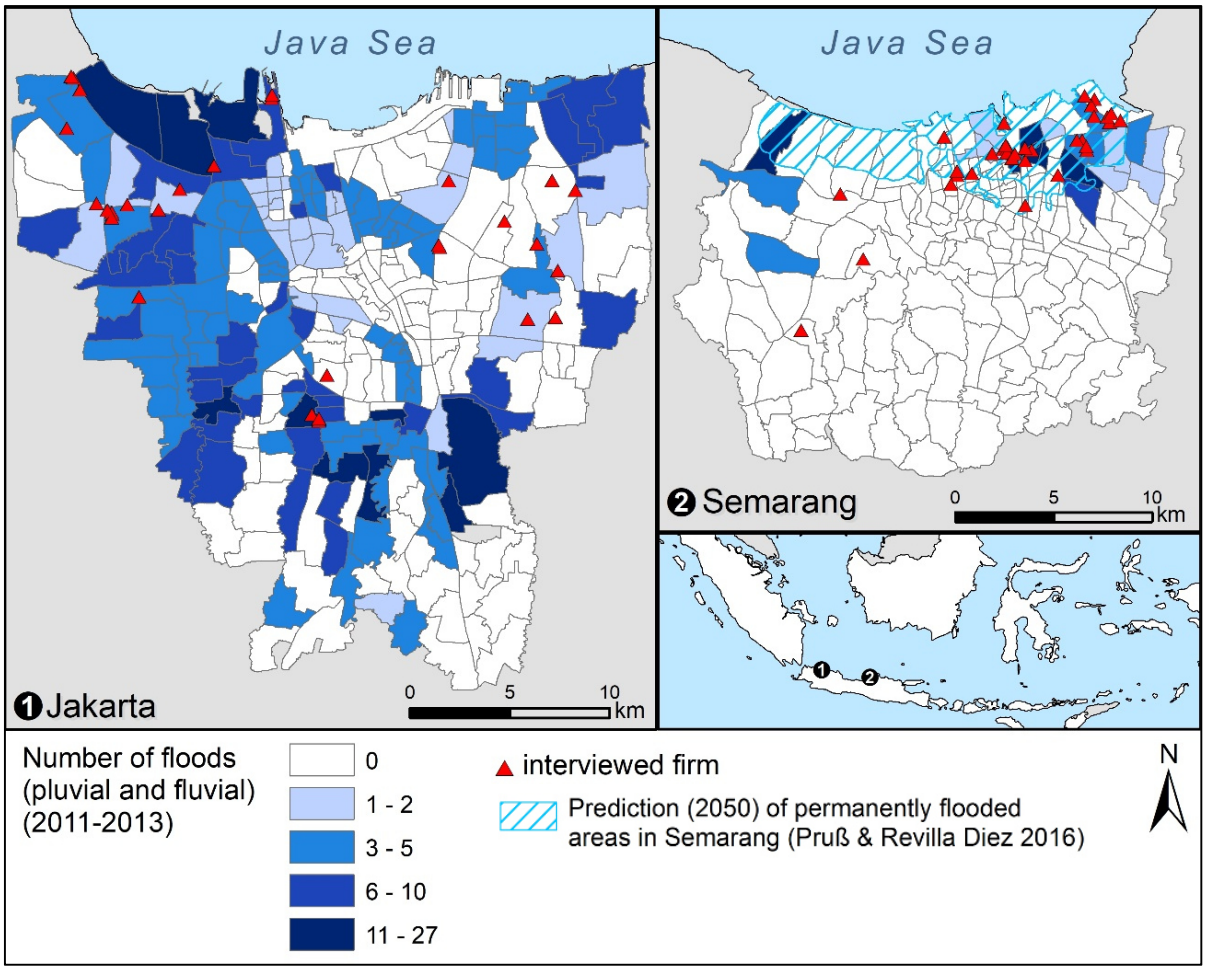


Figure 2-3: Locations of interviewed manufacturing firms (Data: Author's interview; BPS INDONESIA, 2015a, 2015c; Design: Thomas Neise and Lena Krist)[32]

All interviews were conducted together with researchers from the Indonesian Institute of Sciences (LIPI). Hence it was possible to prevent language and intercultural misunderstanding. The interviewees could answer either in Indonesian or in English. The interviews lasted between 45 and 90 minutes and were recorded. The material was subsequently transcribed in English, but the transcription of the Indonesian interviews is based on the original Indonesian responses. The interviewees were also encouraged to illustrate their statements (e. g., regarding a newly planned dike system). When the firm permitted it, we also visited the production site, and the interviewees demonstrated and explained the flood adaptation measures.

The same guideline was used in all interviews, but due to the semi-structured form, the interviewees had the chance to mention additional remarks that were relevant for the topic of

[32] Interviewees in additional sub-districts (Kelapa Gading and Pulo Gadung) in Jakarta were conducted since information during the field research revealed that also firms in these sub-districts are exposed to floods. The conducted interviews in the sub-districts Ngaliyan and Mijen were with firms that relocated from flood-prone areas.

the interviews (BERNARD, 2006; HELFFERICH, 2011). Accordingly, at the end of the interview, the interviewees were asked directly whether they have additional notes.

The semi-structured questionnaire consisted of five parts. The first part dealt with questions about basic information of the firm (e.g., establishment, number of employees, ownership and business development in the last ten years). As many firms did not provide such information on their website or do not have a website, this data was collected at the beginning of the interviews. In the second part, the questionnaire was about the firms′ strategic decision-making, for instance, the responsibilities for the risk management in the firm and whether firms had to deal with business risks (e.g., declining demand, production stop due to natural hazards). The third part dealt with the direct and indirect business impacts of natural hazards. The fourth part consisted of questions about the firms′ individual adaptation actions, followed by a part regarding collective adaptation. The guideline questions dealt with the question of whether firms pursue joint activities for disaster risk reduction. Furthermore, we asked whether the firms were aware of cooperation between neighboring firms, political authorities, and NGOs in their neighborhood. Besides, the interviewees were asked which collective adaptation initiatives are needed and whether they are willing to participate. The institutional setting was discussed in the last part. The interviewees were asked about advantages and disadvantages of the regulation procedures (e.g., laws, permissions for business licenses), labor market, infrastructure (e.g., road quality, access to harbor or airport), and environmental regulations. Based on the mentioned shortcomings, the interviewees were asked how the firms handle those.

Furthermore, 31 expert interviews[33] have been conducted between March 2015 and April 2017. Leading Indonesian scientists on regional planning (e.g., Institut Teknologi Bandung and Universitas Diponegoro) and land subsidence (e.g., Universitas Gadjah Mada and Universitas Diponegoro) were interviewed. Also, expert interviews were conducted with representatives of business associations (e.g., European Chamber of Commerce and Indonesian Business Council for Sustainable Development), industrial park management authorities (e.g., in Semarang KIW and TEPZ, in Jakarta JIEP and KBN Cakung), and NGOs (e.g., Mercy Corps, Dompet Dhuafa). The expert interviews with local political authorities (e.g., head of Kelurahan Rawa Buaya, Kamal Muara (Jakarta) as well as Kelurahan Tanjung Mas and Bandarharjo, Semarang) provided valuable information about local exposures to floods and land subsidence. Also, the interviewees explained state-led flood mitigation projects (e.g., polder systems). Interviews with the BNPB and the BPBDs of Jakarta and Semarang gave an understanding about the disaster

[33] Annex A provides a detailed list of all interviewees (cf. Table A-2).

response procedures and provided information about disaster communication policy. I also conducted interviews with flood mitigation and coastal protection authorities. For instance, I collected information about the river normalization program of Jakarta from interviews with BBWSC Ciliwung Cisadane[34] and DKI Jakarta Public Works′ representatives. Field trips and an interview with a representative of the National Capital Integrated Coastal Development (NCICD) provided valuable information about the progress of coastal protection and the shortcomings in tackling Jakarta′s land subsidence. I collected more information about Jakarta′s land subsidence from an interview with the head of Jakarta′s groundwater conservation agency. Information about the land subsidence and flood mitigation projects in Semarang were gathered by an interview with the local spatial planning authority of Semarang (*Bappeda Kota Semarang*). In sum, besides providing additional information about the disaster management policy, the interviews with the political authorities also dealt with the – sometimes lacking – cooperation of political authorities with firms on flood adaptation initiatives and the respective regulations that facilitate or hamper public-private partnerships.

The in-depth firms′ interviews were analyzed following the principles of the structured qualitative content analysis (e.g., MAYRING, 2015). This technique is commonly applied in order to seek to explore a phenomenon that is theoretically and conceptually underresearched in the literature (KONDRACKI et al., 2002). The knowledge and rationales of the interviewees that are grounded in the data material can be systemically analyzed (HSIEH & SHANNON, 2005; MAYRING, 2015). In particular, the content analysis aimed to identify the similarities and dissimilarities of firms′ adaptation strategies with regard to their location, business size, resources, and flood experience. Therefore, predetermined code categories were derived from prior research on firms′ exposure to floods and strategic decision-making as well as from the conceptual considerations of the own analytical framework, the IARD-framework (cf. Chapter 3). During three analytical iterations of the data materials, the code categories were more precise, and new code categories were included if novel issues came up. The software MAXQDA (version 12) was used in order to analyze all interview transcripts and minutes and generate new code categories.

[34] BBWSC Ciliwung Cisadane is carrying out a part of the JEDI-project.

2.3.3 Scenario-based field experiments

The second empirical step to collect primary data were the scenario-based field experiments. Field experiments allow for a deeper understanding of the contextual dimensions underlying decision-making of participants (e.g., risk attitude, trust) that determine their willingness to participate in collective actions (CARDENAS, 2003; EHMKE & SHOGREN, 2009). The comparison of various treatments with different interventions (here manipulated scenarios) enabled to detect how different micro social, economic, and institutional variables determined the cooperative behavior (CARDENAS, 2011; DUFLO, 2006). Although laboratory experiments can deliver essential findings on cooperative behavior, their generalization in a natural setting is contested (CROSON et al., 2007; LEVITT & LIST, 2007). In contrast, field experiments oftentimes deliver more realistic results because they are conducted in a natural setting that creates a feeling of familiarity (HARRISON & LIST, 2004). Moreover, the field experiment allows putting the results into practice, for instance by policymakers (DELMAS & ARAGON-CORREA, 2016). Since the field setting might influence the responses unintentionally, field experiments lack external validity. Therefore, the results cannot be transferred automatically to different conceptualizations and/or participant groups. (BARDSLEY, 2010; CARDENAS, 2003; DUFLO, 2006; HARRISON & LIST, 2004).

The scenario-based field experiments relied on the results of the first empirical analysis. The in-depth interviews revealed that particularly micro-, small and medium-sized enterprises (MSMEs) barely participated in collection adaption measures. 120 MSMEs of the manufacturing sector were selected randomly if they had no more than 250 employees[35] and their business had been disrupted by floods within the last five years. The selection process was similar to the selection process for the in-depth interviews of SMEs. (cf. Section 2.3.2). The scenario-based field experiments were conducted with the business owners or directors of the MSME between September and December 2016 at similar sub-districts in Jakarta and Semarang (cf. Figure 2-4).

[35] The classification of MSMEs derives from the official classification by the Indonesian statistics authority (BPS) that draws the line at 100 employees (cf. BPS INDONESIA, 2015a). The definition of MSMEs relies on the frequently applied definition by the EU that call all firms with up to 250 employees MSMEs (cf. EUROPEAN UNION, 2015).

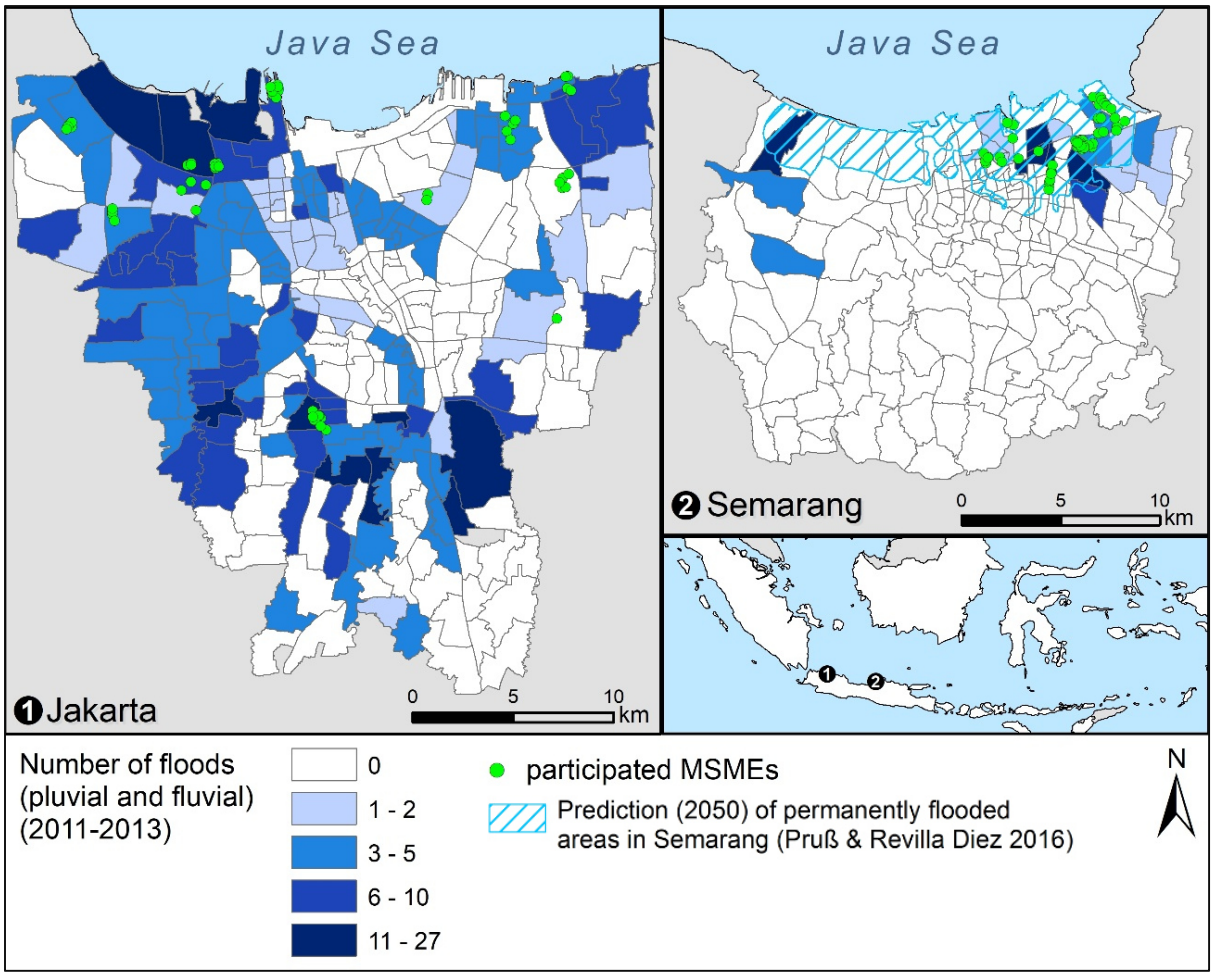


Figure 2-4: Locations of participated MSMEs in the scenario-based field experiments (Data: Author′s interview; BPS INDONESIA, 2015c; Design: Thomas Neise and Lena Krist)

For the conceptualization of the scenarios, insights from the in-depth interviews, expert interviews and field observations were considered. The visits of many flood-prone locations of manufacturing firms provided a valuable overview of the local setting that provokes flooding (e.g., clogged waterways) and the typical urban architecture. These insights were used in order to design a typical but generalized urban setting for the field experiments. This allowed that the participants could picture the stylized setting in which the scenario-based field experiments were conducted. Moreover, the in-depth interviews with the firms′ representatives and the focus interviews with the political authorities revealed desired flood risk reduction measures and the role of the political authorities. This information was included in the design of the scenarios. The draft of the scenario design was reviewed by and discussed with Indonesian experts at the LIPI and scholars from behavioral economics (Prof. Dr. Rockenbach and her team, University of Cologne). After the revision, the scenarios were pretested in the field. The design and the content were slightly adjusted in order to prevent misunderstanding by the participants. The scenario-based field experiments were conducted jointly with researchers from the LIPI. All

field experiments took place in Indonesian. The given answers were written down and subsequently converted into variables for data processing.

In total, the scenario-based field experiments consist of three empirical steps. First, the participants′ risk attitude was collected by a short decision game. The participants were asked to choose whether they would take the risk to change their selling strategy and export their product. This option A (i.e., risk-seeking option) includes a 50 % chance to gain more revenues but also a 50 % chance to increase their losses. The option B (i.e., risk-averse option) entails that the participants opt to continue the sole domestic selling strategy. The collected information about the participants′ risk behavior was included as an explanatory variable to detect the MSMEs′ willingness to contribute to a joint flood risk reduction measure.

Second, a one-shot public goods game was conducted that contains 15 different scenarios. The rationales of the public goods game rely on the voluntary contribution mechanism that is commonly applied in order to examine the individual contribution to a public good of a participant (ONES & PUTTERMAN, 2007). Since flood risk reduction measures (FRRM) are typically a discrete public good the provision point mechanism (PPM) with a money-back guarantee[36] was included. The provision of FRRM requires a certain amount (i.e., threshold) of funding that cannot be provided solely by one actor alone. Therefore, a joint contribution is needed (MARKS & CROSON, 1998; GROOTHUIS & WHITEHEAD, 2009). The design of the scenarios is based on the methodological consideration of the vignette studies. The scenarios were conceptualized in the form of vignettes that are carefully designed descriptions of realistic but hypothetical situations. They should be judged by the respondents (ATZMÜLLER & STEINER, 2010; OLL et al., 2018; WALLANDER, 2009). In total, 15 different scenarios were designed.

Third, a short survey was conducted in order to collect respondent-related information as dependent variables (ATZMÜLLER & STEINER, 2010). The survey contains questions about general business information (e.g., year of establishment, number of employees), their flood exposure, individual adaptation measures and the evaluation of the institutional environment.

In total, 120 participants, 60 each in Jakarta and Semarang, participated in the scenario-based field experiments. As each participant has to play each of the fifteen scenarios 1.800 observations (120 firms x 15 number of scenarios) were gathered.

[36] If the requested provision point is not reached, the participants' contribution will be refunded (CADSBY & MAYNES, 1999).

The collected primary data were analyzed through a multi-level binary-logistic regression[37] via STATA (version 13). In this respect, I followed the recommendations from researchers that deal with the methodological considerations of vignette studies (e.g., ATZMÜLLER & STEINER, 2010; HOX et al., 1991; WALLANDER, 2009). The data consists of a hierarchical structure because each participant played all fifteen scenarios. Thus, the answered vignettes (i.e., scenarios) of each participant is determined by his/her individual characteristics (e.g., their risk behavior) and also, probably nested in the spatial context (e.g., flood exposure, location site).

If a single equation (e.g., single-level logistic regression analysis) with all independent variables – despite their usual hierarchical structure – would be computed then the higher levels (i.e., individual and contextual variables) would be treated as a scenario-level variable (HUNDT & STERNBERG, 2016). Consequently, a single-level logistic regression analysis would cause a systematic underestimation of the standard errors as the residuals would not be treated independently (BRYK & RAUDENBUSH, 1992; ROOKS et al., 2000).

Multi-level models allow to differ between the scenario-, individual- and spatial-levels (PARK et al., 2010). This was also in line with the research′s interest to analyze whether firms′ individual or spatial characteristics determine the cooperative behavior of MSMEs.

[37] Multi-level analyses are also called hierarchical linear model or random coefficient model (BRYK & RAUDENBUSH, 1992; HOX et al., 1991).

3 Firms as drivers of integrative adaptive regional development in the context of environmental hazards in developing countries and emerging economies – A conceptual framework

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Abstract

Many industrial sites in developing countries and emerging economies face increasing exposure to environmental hazards, e.g., in coastal locations, while being situated within the territory of state authorities which lack in capacity to provide adaptation solutions. It is therefore relevant to ask, whether and how firms engage in adaptation, both individually and collectively, in order to reduce business disruptions, enhance their competitiveness and shape regional development. However, the literature has made little efforts to address these questions conceptually and empirically. The paper, therefore, develops a heuristic conceptual framework for deciphering the decision-making of firms exposed to environmental hazards and the role that they might play for shaping larger risk governance and eventually regional adaptation. In doing so, the paper builds on both an explorative empirical study in Jakarta and Semarang and the assessment of different literatures of relevance to the topic. The proposed framework argues that firms potentially fulfill a twofold role in shaping integrative adaptive regional development when exposed to environmental hazards.

First, firms seek to enhance their own competitiveness through adjustments which are determined by their routines, risk behavior, and the institutional setting. Second, firms act as stakeholders within broader collective adaptation. In conclusion, the framework suggests that firms′ (in-)actions can shift the trajectories of regional development into different directions, along a gradient from collapse, resistance, resilience to transformation. The framework can be used to guide empirical analysis and inspire policy-making and practice of integrated adaptation governance, especially in rapidly changing developing countries and emerging economies.

Keywords

Firms, adaptation, regional development, environmental hazards, developing countries

3.1 Introduction

This paper addresses an important yet paradoxical gap in current scholarship: While firms are at the frontline in terms of suffering loss and damage from disasters related to environmental hazards (floods, storms, etc.), their capacity and willingness to engage in individual and/or collective action for risk reduction is little understood. Gaining a better understanding of whether and how firms drive forward adaptation individually and contribute to collective adaptation towards environmental hazards is of key importance for a number of reasons, we argue:

First, as the number and intensity of disasters related to environmental hazards are on the rise globally, especially the economic losses from disasters are growing. Data from the reinsurance industry suggest that the amount of economic losses has risen by about 36 % between the decades of 1997 to 2006 and 2007 to 2016 (MUNICH RE, 2017). The economic impact is relatively high in many emerging economies such as Bangladesh, Vietnam or Indonesia due to their high exposure of valuable assets (e.g., critical infrastructure at the coastline) combined with high vulnerabilities and low protection levels. The average share of economic losses to the respective GDP is about 1 % in emerging economies (between 2001 and 2006) and 10 times higher than the average in developed countries (WORLD BANK, 2012). While these data mostly consider insured assets and losses in the formal economy, additional assessments suggest that the overall economic losses are even higher, when informal economies are considered (HALLEGATTE et al., 2016; 2017). The latter are prevalent especially in developing countries and emerging economies, i.e., lower and upper-middle-income countries according to the World Bank (2017) classification.

Second, with a further growth in the intensity and frequency of environmental hazards expected in the future, driven by climate change and regional to local environmental degradation (IPCC, 2014), the future economic losses from disasters can be expected to rise further. Environmental hazards such as sea level rise and an increase in storm activities, riverine flooding, heat spells, and other hydro-meteorological hazards will present a great challenge to the performance and eventually survival of many firms, especially those in coastal or otherwise exposed areas and those with immovable or hard-to-change infrastructure, such as manufacturing firms.

Third, this to be expected increase in future losses is further driven by the continued development of economic infrastructure and productive assets (e.g., industrial zones) within highly hazard-exposed urbanizing coastal zones (e.g., in and around harbor cities) or along rivers (e.g., for transport and water supply as well as discharge purposes) (JONES & O'NEILL, 2016; SETO et al., 2012).

Fourth, since states oftentimes face difficulties in identifying and enacting effective adaptation and risk reduction measures – especially in developing countries and emerging economies – they leave an adaptation vacuum in which firms need to cater for their own adaptation or even drive collective adaptation strategies for entire regions.

Fifth, adaptation and risk reduction is typically a neglected – at least under-emphasized – field in economic geography. There are therefore many open questions of how firms make adaptation

decisions, become actors in wider (regional) adaptation governance, balance efforts for individual vs. collective adaptation and potentially become central actors in wider (regional) adaptation governance, using their typically strong profiles in terms of innovation, finance, expertise, and social responsibility.

Against the background of these five intersecting aspects, we conducted an explorative field study in Jakarta and Semarang demonstrating that firms mostly rely on individual adaptation measures such as elevating the street level or the plant and establishing pump systems which by far are not sufficient. When it comes to collective action, the firms seem to be trapped in a social dilemma. Therefore, this paper sets out to provide a framework – called integrative adaptive regional development (IARD) – that helps to guide future analysis and practice of firms as adaptation actors in terms of both individual adaptation for securing their competitiveness and collective adaptation for achieving adaptation of entire regions, i.e. spatial and functional entities with shared hazard exposure and/or economic profile.

The paper is structured as follows: The second section outlines the consequences of insufficient engagement of the state on adaptation. The third section presents our case studies: the Indonesian cities Jakarta and Semarang and outlines challenges of manufacturing firms and state authorities to adapt to floods. Based on these examples, we derive our conceptual IARD-framework and explain that we assume a two-folded perspective on how firms can drive adaptation and different outcomes of reconfigured pathways are possible. The fourth section about the need of firms and regions to adapt to environmental hazards decipher both perspectives, individual and collective adaptation through reviewing different approaches. The explanation of the IARD-framework is followed by a brief outlook on potential scenarios of the regional trajectories in the case studies Jakarta and Semarang. The last section provides a conclusion and an outlook for further research.

3.1.1 The role of the state on risk reduction and adaptation

Risk reduction and adaptation are widely and to a large part considered to be within the responsibility of states and lower tier formal public institutions. This is because tasks such as large-scale hazard mapping and risk assessment as well as the provisioning of infrastructure systems for early warning (e.g. through meteorological services), hazard protection (e.g. through dyke systems), response (e.g. through disaster response units and the military) and recovery (e.g. for emergency shelter) typically go beyond the capacity of individual agents within a society and

need state organs for their planning, implementation and maintenance, following the logics of public goods and services (AGUIRRE, 2007; WILLIAMS, 2011; WORLD BANK, 2010). At the same time, adaptation to environmental hazards becomes an increasingly complex challenge given that in a globalizing and diversifying world the number of stakeholders across scales and sectors that need to be involved in risk reduction is rising in most places. Against this increased complexity, a clear division of responsibilities but also the rules for the collaboration among the state actors and other actors of the civil society and the business sector is needed in order to pursue an integrative disaster management that pools the resources of all affected actors but also their specific responsibilities (WILLIAMS, 2011).

State authorities in developed countries are typically considered capable of fulfilling their responsibility for risk reduction, e.g., through maintaining adequate flood protection infrastructure, providing effective planning guidance or enabling and facilitating insurance regimes in response to environmental hazards. However, research suggests that the picture in many developing countries and emerging economies looks different. While many of these countries have implemented laws and regulation on disaster risk management or, more recently, climate change adaptation at the national level, the implementation and effectiveness of respective policies, plans and regulations are often poor (e.g., BIRKMANN et al., 2014; IFRC & UNDP, 2014).

The reasons behind this insufficient provision and effectiveness of state-led risk reduction in developing countries and emerging economies can be manifold. First, many of these countries experience high population growth, rising urbanization, and impressive economic growth. The rapid growth often surpasses the capacity of adequate infrastructure development by the public sector (GARSCHAGEN & ROMERO-LANKAO, 2015). Second, state authorities in these countries often lack financial resources, technological capacities and trained human capital even to establish standard infrastructure such as roads, housing, electricity, education (BIRKMANN et al., 2014; GARSCHAGEN & ROMERO-LANKAO, 2015). Consequently, state authorities face difficulties in providing effective adaptation measures, too, which typically require even more advanced technical skills and larger financial budgets. Third, many of these countries are plagued by overall weak government effectiveness and law enforcement, driven by issues such as crony-capitalism, corruption or exploitive rent-seeking, rather than stringent checks-and-balances for securing decision-making in the interest of the common good (WILLIAMS, 2011). Fourth, authorities in many countries or local municipalities apparently have an incentive in downplaying environmental risks in order to not jeopardizing investments and economic growth (CUTTER et al., 2008). Lastly, conflicting responsibilities of authorities often make it difficult to implement

risk reduction measures which will unfold their potential benefits across administrative constituencies and over longer time frames – even though this challenge also appears to be very dominant in developed countries (FUCHS et al., 2011; HALLEGATTE, 2014).

These obstacles seriously compromise the overall capacity and effectiveness of state action for successful risk reduction and adaptation in many developing countries and emerging economies. As a result, non-state actors are often left with having to bear the major responsibility and costs for adapting themselves and the regions in which they interact and pursue their economic activity. Firms play a particularly important role in this respect since their competitiveness and survival directly hinge on the question of how well environmental hazards, which potentially threaten their performance and economic success, can be minimized through effective adaptation. As firms typically collocate in urban or rural areas, the question further arises whether and how they think and reach beyond their individual competitiveness and engage in collective action in the interest of regional adaptation – both in response to the insufficient provision of state-led risk reduction and adaptation measures.

In order to protect, for instance, their supply chain, critical infrastructure or the livelihood of their employees firms might have an interest in regional adaptation. These firms′ actions to implement large-scale adaptation will have direct or indirect impacts on the regional development. Effective adaptation can strengthen the regional sustainability through competitive firms that create, for instance, jobs, tax revenues and by a more advanced infrastructure (e.g., transport ways, power supply) that is also beneficial during times of no hazard events. However, also the opposite is possible. Insufficient adaptation or the absence of any engagement on adaptation can lead to a socioeconomic downgrading (e.g., bankruptcy of firms, abandoned settlements). How firms′ adaptation and their impact on regional adaptation can be conceptualized is therefore of great relevance.

3.1.2 Indonesian coastal cities′ exposure to floods – The examples Jakarta and Semarang

Indonesia is a prime example of the aforementioned challenges. The country is exposed to several environmental hazards (e.g., floods, earthquakes or forest fires). Especially, the coastal areas face a huge amount of damages through environmental hazards since the population and economic activities are concentrated here. At the same time, Indonesia exemplifies that state authorities face difficulties to fulfill their responsibilities on risk reduction and adaptation due to lacking financial budgets and weak government effectiveness.

The disastrous Boxing Day Tsunami 2004 that devastated the northern part of Sumatra and the earthquake in Yogyakarta 2006 can be seen as turning points reforming disaster management policy. The Indonesian government improved their legislation on disaster risk reduction particularly by the newly launched disaster management law No. 24/2007. Based on this law, the National Agency of Disaster Management (BNPB) was established, and the provinces and regencies were encouraged to establish local disaster management agencies. Inspired by the Hyogo Framework for Action, partnerships in disaster management were strengthened legislatively. The law underpins inter alia the collaboration between the government, civil society and the private sector on disaster risk reduction (IZUMI & SHAW, 2015). Although Indonesia has achieved a considerable progress regarding disaster management policy and the government implemented joint activities with international organizations and NGOs to integrate the community, the business sector has mostly been neglected (DJALANTE & GARSCHAGEN, 2017).

Taking a regional perspective, Jakarta and Semarang well illustrate that manufacturing firms are heavily exposed to floods and that the state authorities are challenged to provide adequate adaptation measures to floods for the entire city areas. Jakarta is primarily facing pluvial and fluvial floods that affect the city several times a year. But, for instance, in 2007 and 2012 massive floods inundated more than half of the metropolis over weeks and the social and business life was paralyzed for months (PETERS et al., 2015). Semarang, on the other, mainly experiences tidal floods several times per year. These flood events are not perceived as shocks, but rather as belonging to the city′s regular hydrology. In both cities, land subsidence, coastal erosion and the sea level rise add to the flood hazard in both Jakarta and Semarang (FIRMAN et al., 2011; MARFAI & KING, 2007).

The manufacturing sector, which is of great economic importance in both cities, is particularly affected. Manufacturing firms are primarily concentrated in the northern coastal parts of both cities. These are also the areas with the highest number of flood events. Although this location yields economic benefits (e.g., easier transportation facilities), firms suffer economic losses due to floods and coastal erosion (HALLEGATTE, 2014). Therefore, it is interesting to understand how firms seek to overcome this dilemma, weigh the economic benefits and losses of their location and engage in adaptation solutions to maintain or even enhance their competitiveness despite the flooding conditions in their locations.

In order to understand whether and how manufacturing firms engage in adaptation and which role state authorities have in supporting adaptation processes, we conducted an explorative field study in both cities. Between 2015 and 2017, we interviewed 67 affected manufacturing firms,

five scientific experts, four representatives from NGOs or community-based adaptation initiatives and eight political decision-makers.

Manufacturing firms in both cities were found to engage in adaptation but primarily rely on individual adaptation measures. These include, most prominently the elevation of streets or plant facilities as well as the installation of pumping capacities. In doing so, most firms established procedures of response, but often intensify them progressively, e.g., pumping capacities. In Jakarta, however, the massive losses in the 2007 and 2012 floods pushed firms to modify their adaptation and find novel solutions to continue their businesses even during floods. For instance, medium-sized and large-scale firms established emergency response teams and changed their production procedures, e.g., increasing their storage facilities. In contrast, such initiatives were hard to find in Semarang. Most of the firms rely on long-established adaptation measures (e.g., pumps). Substantial risk mitigation strategies against the increasing tidal flooding and coastal erosion are mostly not undertaken. Apparently, the firms in Semarang are unable to break their (mal)adaptation trajectories. The data suggest that this is due to the firms′ comparatively low competitiveness and thus, limited financial resources for more progressive adaptation.

With regard to collective adaptation, the picture in Jakarta is again different from that in Semarang. Since the massive floods in 2007 and 2012, Jakarta′s city authority with the support of the World Bank and the Japan International Cooperation Agency undertook river normalization, uplifting of streets and the relocation of river bank settlements primarily in commercial and residential areas of the central business district. In addition, large scale domestic and multinational firms in the northeastern district Cakung financed and executed flood risk reduction measures – a more sophisticated pumping system and a drainage canal. The initiative emerged from a multinational firm that realized that its individual onsite adaptation measures such as pump systems and elevation of plant facilities were not protecting the production sufficiently. Together with nearby firms, possible solutions were reviewed, and the nearby residents were included into the final decision-making. However, the implementation was delayed for years by lacking permission of the city authorities. It was implemented just recently.

In the second largest industrial site in the Northwest of Jakarta where medium-sized domestic firms are dominant, however, no engagement in collective adaptation could be observed. These firms rather rely on individual adaptation efforts or just try to survive under the hazard-prone conditions. Due to limited capabilities, many firms rather pursue a ‘wait-and-see’ strategy. There is no collaboration between the firms and other stakeholder. Also, the city authorities do

not have plans to implement larger pump systems or normalize the river. The interview data suggest two key reasons: First, the city budget constraints investments into large-scale adaptation measures. Second, the city plans to convert most of the industrial area into residential and commercial areas. Consequently, manufacturing firms that are interested in collective adaptation receive no governmental support.

In Semarang, low engagement with collective adaptation was found. This is a remarkable situation since the impacts of floods and coastal erosion can be hardly tackled by individual, small-scale adaptation. In the case of Genuk, the largest concentration of manufacturing firms and most exposed area to floods, land subsidence and coastal erosion in Semarang, the city authorities do not feel responsible because the site is privately owned. However, the industrial estate management is perceived as unreliable and ignorant by the tenants. Consequently, firms, with sufficient financial resources, jointly elevated the access roads to their plants. However, this small-scaled collective adaptation is an exception and was undertaken by a few neighboring firms (less than five firms). Furthermore, it is questionable whether this adaptation is comprehensive enough to protect the industrial site in the long run. More systemic collective action by all firms, industrial estate management and the city authorities that improves the conditions at large could not be observed. Firms mostly act on their own and try to find solutions to tackle their individual exposure to floods.

These both examples indicate the need of manufacturing firms for adaptation, both individually and collectively. In terms of individual adaptation, the case studies show that many firms are trapped in their trajectories of (mal)adaptation and particularly in Semarang face difficulties to respond to the increasing exposure to environmental hazards by breaking through their routines (i.e., firms′ specific structures and actions). As the case of Jakarta has shown extreme flood events can be triggers for firms to adjust their strategies on (mal)adaptation. On the contrary, the slowly deteriorating situation in Semarang barely changed firms′ (mal)adaptation strategies.

In sum, not all the firms are adapting to environmental risks thus changing their organizational routines. This means that in order to understand firms′ unwillingness or incapacity to adapt, a better understanding of their decision-making is needed. The case studies also revealed that collaboration between state authorities, civil society and among firms is often lacking, despite the fact that it would be needed for adapting more effectively. Since state authorities are overstrained to provide adequate large-scale adaptation more engagement, for instance, by firms is needed. However, our explorative case studies indicate that the willingness to act collectively

is limited. Firms′ engagement to collective adaptation is typically not facilitated by governmental support. At the same time, the firms are mostly reluctant to overcome their immediate self-interest for protecting their business against exposure to environmental hazards. Especially in Semarang, the willingness to engage in collective adaptation is limited. Hence, it is necessary to analyze how collective adaptation might take place and under which circumstances actors are willing to join collective action. Along the same line, it is then also important to ask how individual and collective adaptation will impact regional development.

Even though several scientific disciplines are interested in how firms adapt to changes, take decisions in the context of uncertainty and engage in collective action, a comprehensive framework on how firms can drive adaptation to environmental hazards is still missing. Our framework aims to understand the situations in Jakarta and Semarang, which resemble similar contexts in developing countries and emerging economies.

3.2 The integrative adaptive regional development (IARD) framework

The IARD framework is proposed here as a basis for the analysis on how and under which conditions firms engage in individual or collective adaptation, and by doing so contribute to integrative adaptive regional development (cf. Figure 3-1). Integrative adaptation means here the ability of firms, together with other actor groups, to utilize and/or increase their capacities to respond to change of economic, social, and ecological conditions in order to reduce the exposure to environmental hazards, individually and collectively. Adaptation is seen as an iterative path-dependent process that is shaped by the risk anticipation and decision-making of the respective actor (ADGER et al., 2005; GALLOPÍN 2006; GROTHMANN & PATT, 2005). However, avoiding individual or collective adaptation and engaging in failed or even counter-effective maladaptation is seen here to possibly lead to an increase in the firms′ and regions′ risk profile (BARNETT & O'NEILL, 2010; GROTHMANN & PATT, 2005).

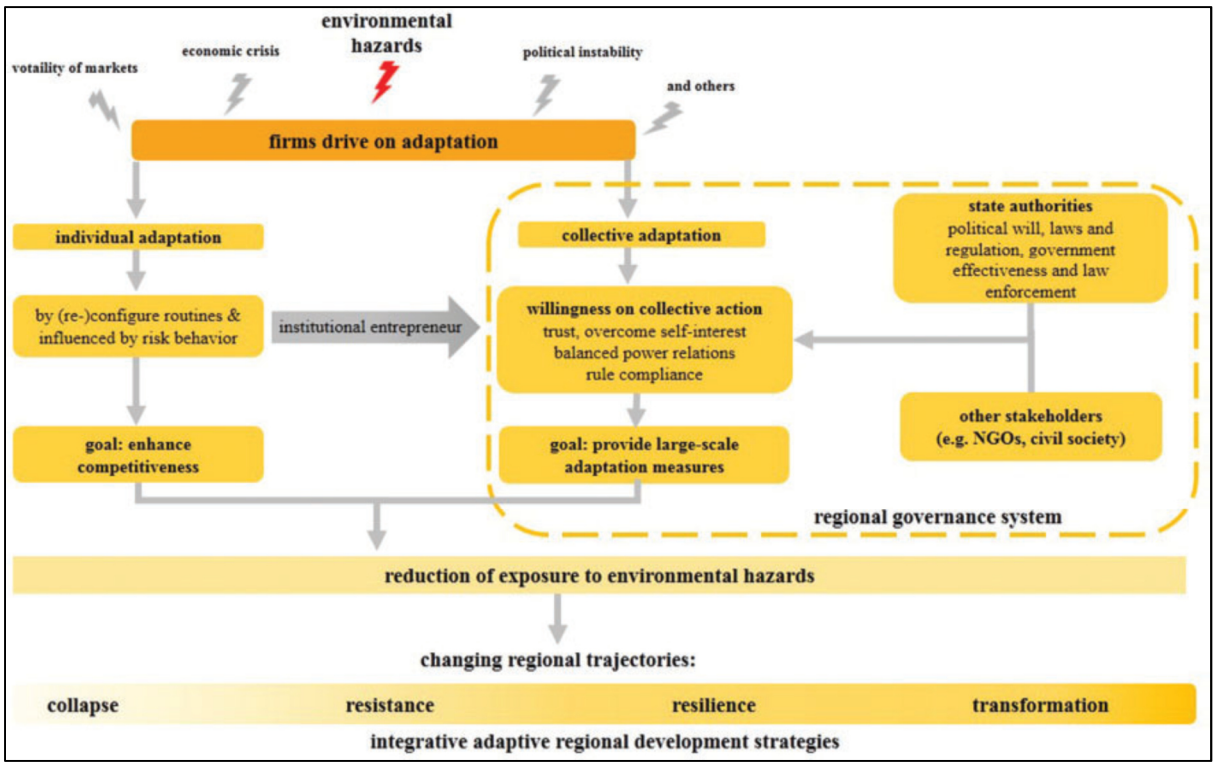

Figure 3-1: IARD framework (own illustration)

Whether and how firms drive adaptation efforts should be seen from two perspectives. First, firms need to adapt individually to environmental hazards in order to enhance their competitiveness. Research by organizational studies and evolutionary economic geography has pointed out that firms′ strive to enhance competitiveness through continuous adaptation of their organizational routines (i.e., firms′ specific structures and actions). Improving routines enable firms to respond to changing market or environmental conditions (FRENKEN & BOSCHMA, 2007; NELSON & WINTER, 1982). The outcome of individual adaptation will primarily affect the firms′ own competitiveness, but the outcomes can positively alter other firms and stakeholders who imitate these effective activities. Additionally, individual adaptation can have positive but also negative side-effects for other actors. For instance, an emergency pump can on the one hand help to decrease the inundation for the surrounding firms or residential areas. On the other hand, the disposal of the pumped water might inundate other areas and affect firms and residential areas. Furthermore, if firms can compete well on the market, they will have positive effects on employment, tax revenues, etc. On the other side, individual maladaptation will contribute to risk and decrease the competitiveness (worst-case scenario: bankruptcy). This eventually contributes negatively to wider socio-economic effects (e.g., employment, tax revenues).

Second, firms can be important players for collective adaptation in regional governance systems, together with other stakeholders, such as other firms, the community, government agencies, civil society organizations, and international development organizations. Collective adaptation is characterized as collaborative activities that firms are initiating or within which they are participating together with these other stakeholders. The goal of these activities is to implement adaptation measures which cover broader areas, for instance, entire neighborhoods. Striving for collective adaptation requires that the members of the governance system minimize their pure self-interest by negotiation and punishing free-riding (OSTROM, 2000). Engagement on collective adaptation is not cost-neutral for firms. But in many contexts, joint adaptation measures will be more effective than individual ones. For instance, each individual firm will benefit from widening rivers or implementing a polder system on the base of cost sharing. Individual firms can hardly finance and legitimize such large-scale adaptation measures on their own. The outcome of collective adaptation is particularly necessary to tackle large-scale risk-causing factors such as coastal erosion, land subsidence, and clogged rivers.

Therefore, we assume that firms′ engagement on adaptation together with other stakeholders and by the legitimization of state authorities can shape different regional trajectories. In line with Solecki et al. (2017), the outcomes of integrative adaptive regional development can have diverse forms ranging from resistance to resilience and transformation or collapse as an unintended effect of inaction, or the incapacity of effective (joint) adaptation action. Resistance means that actors try to keep the current system and its configurations (e.g., power relations) stable, despite increasing external stress such as the rise in the frequency and intensity of flooding. It implies rising input resources, for instance, protecting the infrastructure and strengthening rigid institutional or bio-physical structures. Resistance often involves conventional engineered solutions with a focus on the built infrastructure, e.g., coastal defense systems. On the individual firms′ perspective, resistance can be for instance the intensification of already existing options such as emergency pumps or backup generators.

Resilience implies slight adjustments of the current regional trajectory to improve the ability to deal with external stress and crisis situations. However, the main regional configuration is typically not being questioned. Resilience can rather be understood as an ‘adjustment at the margins’, which ultimately has the aim of stabilizing the core fabric of the existing regional system in the face of potential external disturbance. The danger is that these minor changes hamper or delay essential major ones. Therefore, the resilience paradigm can in effect work against the need for more fundamental changes (HANDMER & DOVERS, 1996; HOLLING & GUNDERSON,

2002). Examples for resilience can be individually the adjustment of supply chains (e.g., in terms of emergency contingencies for just-in-time systems). Collective adaptation of resilience can be the upgrading of existing protection systems (e.g., for improved dykes infrastructures) or the modernization in early warning systems (e.g., through online solutions).

In contrast, transformation is viewed as a form of adaptation that fundamentally questions the set-up and fit of a current regional system, its risk mitigation strategies and adaptation patterns (PELLING, 2011). The underlying threats of hazardous events are more likely to be addressed directly. The aim of transformative adaptation is, therefore, to initiate a new regional trajectory, i.e., applying novel routines that increase the long-term regional sustainability by minimizing risks or rigidity traps and collapse, and by establishing co-benefits from new development trajectories. This outcome requires a more risk-prone attitude, flexibility, and a willingness to change behavior and institutional setting (PELLING, 2011). The transformative process can be painful and not beneficial for every actor within the governance system. In addition, the risk of maladaptation is higher compared to the resistance or resilience trajectory, but the potential long-term benefits of successful effective transformation can be significant. Flexibility and high adaptive capacities can reduce the risk of negative consequences (HANDMER & DOVERS, 1996; NELSON et al., 2007). A typical example of individual adaptation can be the relocation of production facilities. A collective adaptation can be the regional shift in economic activity from one sector to another (e.g., from manufacturing into services).

Collapse constitutes the most severe outcome, occurring if no adaptation or maladaptation is undertaken. In such a situation, the whole regional configuration can be locked-in and incapable of adapting effectively. Reasons of a collapse can include the failure of state authorities to engage in countermeasures against environmental hazards or firms pursuing a ‘wait-and-see’-strategy (SOLECKI et al., 2017). Consequently, the regional economic consequences might be the exodus or bankruptcy of firms, which would lead to socioeconomic downgrading in the entire region. In order to better understand which factors influence the described outcomes, we discuss determinants for individual and collective adaptation in the two following sections.

3.3 Firms′ need and willingness to adapt to environmental hazards

The case studies of Jakarta and Semarang have shown that firms are exposed to environmental hazards and their individual adaptation is mostly shaped by long-established solutions, such as pump systems. The field study also revealed that the firms need to break through their routines since the exposure to environmental hazards is increasing and cannot fully be covered by the existing routines. The interviews showed that firms, however, face difficulties to modify their adaptation due to limited resources or constraints of the business environment (e.g., increasing competition). Accordingly, it is necessary to understand how firms utilize their skills, technologies, and resources in order to adapt to environmental hazards. Moreover, it is important to understand how firms can incorporate effort on adaptation with respect to their typical business strategies for enhancing their competitiveness.

Since decades, particularly organizational studies stress that routines are crucial for firms to establish decision-making procedures and internal capabilities to respond effectively to economic, social, and environmental changes. Generally, routines are firms′ specific structures and actions which shape future behavior and decision-making. Routines incorporate stability and change and are adapted if firms experience new situations or common decision-making fails (BERKHOUT et al., 2006; NELSON & WINTER, 1982). They are derived from former routines (e.g., experience, skills or tacit knowledge) and are determined by the institutional landscape (FRENKEN & BOSCHMA, 2007). The firms′ capability to replicate or adjust their routines when market and environment conditions change, enable firms to enhance their competitiveness (FRENKEN & BOSCHMA, 2007; NELSON & WINTER, 1982).

Until now, research on adaptation to risks and environmental hazards – particularly on communities and households – typically stress the term ‘adaptive capacity’ which can be interpreted as organizational routine. With regard to firms, the concept of adaptive capacities provides an important emphasis on the endowment of resources and capabilities that firms hold in order to adjust or utilize their routines. In particular, the limitation of adaptive capacities and the false judgment of one′s own adaptive capacities should be taken into account to understand firms′ individual adaptation. It might explain why firms rely on their established routines because they will lean on existing competencies and are unlikely to generate new knowledge in view of an evolving and uncertain landscape, so their competencies become inflexible (COHEN & LEVINTHAL, 1990; LEONARD-BARTON, 1992). Also, false judgment, particularly during times of considerable uncertainty, can lead to ineffective adaptation or maladaptation (GROTHMANN & PATT, 2005). For instance, production or storage redundancies in order to respond more flexible

during shock events tie up resources that can be a financial or organizational burden during time of no shocks. This burden can limit resources for innovating new products and services. Trade-off of distributing resources is accelerated by the uncertainty when shocks will occur.

Decision-making in the context of risk

As we have seen in our interviewed firms, the impact of environmental hazards is relatively uncertain, and the firms sometimes hesitated to invest in more sophisticated adaptation because the current losses by floods and coastal erosion can still be covered. This low engagement on adaptation raises concerns on how firms can still survive in view of the increasing long-term exposure, for instance, to floods. Apparently, the firms′ risk behavior plays a crucial role in their engagement on individual adaptation. Some firms might also be paralyzed by the environmental hazards since their low competitiveness does not enable more investment in adaptation. Accordingly, it is important to understand how firms see environmental hazards as a threat for their viability. Environmental hazards oftentimes occur irregularly, and their impact on firms′ competitiveness will just happen gradually. This means firms face a great uncertainty to what extent they should adapt to them – and when.

Behavioral economics provide several theorems of cognitive biases that determine the rationally bounded risk behavior of decision-makers. Given the huge amount of different explanatory factors that have been detected by behavioral economics and the limited scope within this paper, we focus on one of the most seminal theorems. Most of the current empirical evidence by behavioral economics on decision-making in the context of risk refers to the prospect theory of Kahneman and Tversky (1979). The most seminal contribution of the prospect theory is the loss aversion theorem. It explains that decision-makers tend to take less risky decisions (i.e., taking no efforts on adaptation) if they still see a gain as an outcome of their decision and vice versa. With regard to environmental hazards, for instance, Page et al. (2014) showed by a natural experiment after the 2011 Australian floods that homeowners in Brisbane who were directly affected were willing to accept more risky gambles than unaffected ones. Accordingly, it can be assumed that firms are more willing to adapt if the firms face considerable losses by environmental hazards. In contrast to the prospect theory, however, the risk-sensitivity theory argues that decisions are mostly made in response to need. Decision-makers prefer high-risk options in situations of great need because safe, low-risk options are unlikely to fulfill the needs. Accordingly, decision-makers aim rather minimize the probability of inappropriate outcomes in response to their needs than to maximize certain outcomes (MISHRA, 2014; RODE et al.,

1999). These equivocal assumptions and the missing research on how environmental hazards determine firms′ decision-making on adaptation underpin the need to understand the impact of environmental hazards on firms. Therefore, it is necessary to assess which magnitude or scope of environmental hazards, and their respective losses, might push firms to engage in adaptation or intensify their adaptation effort. The overall question should be to understand the careful weighing of firms whether and which scope of adaptation is needed and how firms′ decision-maker are perceiving environmental hazards as a substantial business risk.

As a consequence of this research gap, it is unclear to foresee whether and which adaptation measures will be implemented by the firms. In principle, firms have manifold options that range from hard (e.g., capital-intensive, technologically based) to soft (e.g., organizational) adaptation measures. The choice of the most effective option depends on many factors (e.g., type of hazards, affected asset, routines) and can create many trade-offs (e.g., persistent vs. flexible measure) that firms need to consider (LINNENLUECKE & GRIFFITHS, 2015; NEISE et al., 2017; WEINHOFER & BUSCH, 2013). One of the most drastic adaptations is the partial or even complete relocation of businesses. Especially, when the exposure is strongly influenced by the location of the business, e.g., located in low-lying coastal areas, relocation might be considered an appropriate adaptation option (see examples in LINNENLUECKE et al., 2011). If relocation is seen as too risky or costly, hard in-situ adaptation that focuses on the infrastructure such as investments on protection measures like elevating the plant or reinforcing the building presents an option. Furthermore, the organization of production processes can be modified, e.g., through changes in production capacity, storages or supply chains. A distinctive soft adaptation that addresses the business organization can be the introduction of a business continuity management which incorporates emergency response teams, back-up plans, and redundancies (LINNENLUECKE & GRIFFITHS, 2015).

Moreover, the firms′ engagement in individual adaptation measures might differ based on their size (SMEs vs. large firms) and national origin (domestic vs. multinational). For instance, Haraguchi and Lall (2015) have revealed that due to the flood in Thailand the multinational firm Toshiba rather relocated to the Philippines than adapt locally to the flood exposure and investing in onsite protection. In contrast, domestic SMEs are less mobile due to their local and social embeddedness within the community and more experienced with past hazard events (SHAW & IZUMI, 2015).

In sum, a better understanding of the firms′ rationales, enablers, and barriers of adaptation and their role for choosing between different types of adaptation still needs to be examined.

3.4 Regions′ need to adapt to environmental hazards

The field study has also shown that firms often cannot handle the exposure to environmental hazards on their own. The impact of coastal erosion, land subsidence, or floods affects entire city areas. Hence, adaptation to environmental hazards has to be addressed at least on a regional level, too. In the context of this paper, regions are understood as spatial entities below the level of nation-states which are bound together by common physical geography, economic system, cultural identity, or political administration. Such regions are important entities for adaptation since besides similar hazard profiles they are strongly integrated economically and provide the basis for pooled adaptation funding.

As outlined above, risk reduction and adaptation to environmental hazards are typically the responsibility of the state. However, the Indonesian state authorities – like in many developing and emerging economies – are overstrained to provide adequate risk reduction and adaptation measures. Therefore, the question occurs how affected actor groups, such as firms, might provide or endorse collective engagement on adaptation with governmental support at the regional level.

Firms of a region typically have a shared interest in the economic viability and adaptation of their joint region. However, whether and how this interest also translates into effective collaboration for collective adaptation among the firms with governmental support – and with other actors in the society – often remains unclear. Institutional approaches and governance concepts provide valuable analytical and normative perspectives to guide such an analysis.

3.4.1 Adaptation governance systems and the power of institutions

Several case studies about the successful development and adaptation of regions have shown that regional institutions are important explanatory factors (e.g., GRABHER, 1993; MEYER & REVILLA DIEZ, 2015). Institutions, as place-specific endowments or shared features, create the conditions to adapt more effectively. For instance, trust between regional economic actors can be strengthened, which in turn reduces transaction costs and uncertainty (NORTH, 1994). Recent studies on the Pearl River Delta and the integration of Hong Kong with its hinterland, highlight the importance of informal arrangements between actors along the electronics value chain, enabling firms to respond flexibly to market changes (MEYER & REVILLA DIEZ, 2015; REVILLA DIEZ et al., 2008). We assume that informal institutions are also important for the realization of adaptation measures because of the insufficient role of the state. Therefore, informal institutions

can compensate the lack of state agency. Under these circumstances, engagement on adaptation – particularly collective adaptation – requires trust and reliability among the stakeholders and a functioning governance system (e.g., NEISE et al., 2017).

Lately, many scholars stress the importance of a risk governance in order to adapt more effectively to environmental hazards and to include a wide range of affected actor groups (e.g., FOLKE et al., 2005; LEBEL et al., 2006). Governance, as the arrangements and procedures within a formal and informal institutional landscape, can be seen as the action field where actors exercise their influence, mediate their interests, negotiate their responsibilities, and organize their common affairs at the interface of the state, the private sector and the society (DENTE et al., 2005; GARSCHAGEN, 2014; GARSCHAGEN & KRAAS, 2011; LEBEL et al., 2006; PELLING, 2011). In terms of collective adaptation to environmental hazards, governance systems are assumed to create the institutional structures and policy processes that guide and limit collective actions (RENN & KLINKE, 2013). Moreover, collective adaptation should not only comprise adjustments in the biophysical environment (e.g., by means of dykes or resettlement programs), but also needs to incorporate adjustments in the very institutions of risk management and adaptation governance, such as planning mechanisms and legal frameworks (BIRKMANN et al., 2010; DJALANTE et al., 2011).

Research focusing explicitly on the impact of different types of governance of adaptation is only slowly emerging and is often characterized by normative requests rather than by analytic precision. One of the first seminal insights is provided by Lebel et al. (2006) who argue that deliberation, diverse participation, and open communication are useful factors to foster trust, mutual understanding, and self-organization. Garschagen (2014) showed for the case of Vietnam′s political transformation how state and non-state actors negotiate their different interests, rights, and responsibilities with regard to risk reduction. More generally, developing countries and emerging economies are particularly relevant cases for studying risk governance since the relationship between the state, the private sector, and society in their joint attempt to reduce risk and adapt to environmental hazards is changing dynamically in these settings (GARSCHAGEN, 2014).

3.4.2 Firms′ willingness to collective adaptation and potential regional outcomes

Nevertheless, taking a governance perspective also allows revealing potential rifts and tradeoffs when negotiating collective adaptation. In particular, the effectiveness of adaptation is determined by the willingness of stakeholders to engage in adaptation and perhaps even to change institutions. The field study in Semarang indicated that the willingness of coordinated collective adaptation is lacking. Firms mostly concentrate on individual solutions in order to protect their business. The industrial estate managers show no interest in large-scale adaptation and the state authorities do not feel responsible and are overstrained by the huge complexity of land subsidence, coastal erosion, and floods that affects the entire city′s coastline.

Large-scale adaptation measures, such as constructing a dyke, will change the regional environment for the stakeholders in different ways. It might even have negative effects for some of the stakeholders: For instance, some fishermen may lose their livelihoods when a dyke is constructed. Moreover, the participation of many actors may increase the complexity of decision-making (NELSON et al., 2007), which makes flexible, rapid responses difficult. There is a danger that initiatives pushed forward by the actors of a governance system may not have full societal legitimization or that they may undermine democratic systems if powerful actors shape the regional economic systems solely to their own benefit.

Thus, political legitimacy, i.e., effective institutional processes, cost-efficient handling of public resources, and consideration of public preferences, has to be incorporated into effective governance systems in order to achieve collective adaptation (RENN & KLINKE, 2013).

In this context, the role of the state in supporting collective adaptation appears to be crucial. Although state authorities lack on providing large-scale adaptation due to their limited technical skills and financial budgets they still exercise the authority (e.g., through the formulation of laws and regulations) to allow large-scale adaptation measures (e.g., dykes). Hence, firms′ initiated collective adaptation needs formal, indirect governmental support, even though state authorities will not be actively involved in the implementation of the adaptation measures. The firms′ initiated collective adaptation in Cakung, Jakarta, showed clearly that the governmental support is strongly needed if firms attempt to shoulder the responsibility of implementing large-scale adaptation measures that typically is the responsibility of the state. Such adaptation measures become a common good so that an entire neighborhood will benefit from a lower flood risk. However, the field study also detected that a strong engagement on collective action in order to implement joint largescale adaptation is missing at large.

Research on social dilemmas and common goods has provided important insights in understanding the processes – and barriers – that shape collective action. Most prominently, this includes the seminal work of Ostrom (e.g., 1990) and the extensive empirical work of Agrawal et al. (2013), Cardenas (e.g., 2004) and Janssen (e.g., 2015) about cooperative behavior and the distribution of common goods. The respective research stresses the importance of understanding the underlying decision-making and actions of the actors in order to examine why the actors are willing to cooperate. Furthermore, the empirical research underpins that effective institutions such as rule compliance, sanction mechanisms, the constellation of the governance systems (e.g., size of actor groups, equivalent cost-benefits for all actors) are crucial points for collective actions (JANSSEN, 2015; OSTROM, 2011).

How can firms be active players on collective adaptation within a governance system, e.g., in our case study Semarang? Firms as stakeholders of a governance system can act as "institutional entrepreneur". According to DiMaggio (1988), these actors intend to change established institutional arrangements and seek to set up new or at least modify existing arrangements according to their interests (DIMAGGIO, 1988; GARUD & KARNØE, 2001). Firms as institutional entrepreneurs possess the ability to initiate institutional change proactively in order to achieve better adaptation outcomes. They take leadership to implement change, and while, they are not necessarily politically legitimized, their position in formal and informal leadership systems, and their involvement in activities give them support and de-facto legitimacy (MAGIS, 2010).

Hence, we suggest that firms might first have a pure business interest in implementing broader adaptation jointly with other stakeholders and second, these efforts can enhance their infrastructure and support the livelihood of their affected employees. For instance, small- and medium-sized domestic firms are often the main drivers of local socioeconomic welfare in many hazard-prone countries (PAUW, 2015). Therefore, we argue that they also might have the societal legitimacy and interest to initiate collective adaptation as an institutional entrepreneur.

However, as pointed out by research about collective action, powerful individuals or groups who are interested in maintaining the status quo can hamper initiatives on collective adaptation, or poor, ineffective outcomes can be developed. The variety of different interests within the governance system can endanger effective collective adaptation if no agreement on the strategy is reached. It is crucial that the actors in the governance system are willing to overcome their pure self-interest. In governance systems, the involvement of all the stakeholders concerned may succeed in preventing uncooperative behavior. However, distinct self-interest and power relations make it highly challenging to bring about a smooth, effective collective adaptation.

Therefore, enforced rules (e.g., sanction mechanisms) might be realized to limit or punish individually deviant behavior (OSTROM, 2000).

These difficulties show that IARD typically calls for changes or modifications in prevailing behavior and strategies. In particular, more self-interested behavior that firms might seek will hinder collective adaptation. By doing this and also by rearranging firms′ own routines, it might become more probable that firms act as institutional entrepreneurs and/or active players in a governance system. However, the willingness in changing behavior and strategies might occur gradually and can be hampered by the 'competency trap' (LEVITT & MARCH, 1988).

In consequence, individual and collective adaptation efforts might impact regional development trajectories as described in our IARD-framework. The following scenarios illustrate how regional trajectories could evolve based on our explorative field study in Indonesia:

In Jakarta, signs that the regional trajectory might change from resistance to resilience and partially to transformation can be assumed. Formerly, Jakarta was trapped in a resistance phase and near to a collapse. Firms mostly relied on long-term established routines, such as pump systems and just expanded their capacity to respond to an increasing magnitude of floods. After the flood events in 2007 and 2012, however, many firms adjusted or intensified their existing, individual adaptation measures. Slight modifications were undertaken in order to stabilize the business strategies. These firms′ actions can, therefore, be understood as resilience building. Going beyond such adjustments, particularly medium-sized and large-scale firms implemented novel routines on adaptation which indicate a more transformative rethinking of risk management strategies (e.g., introducing novel emergency response teams). Such measures indicate that firms′ individual adaptation is starting to transform. Also, the intensified engagement by the city authorities on large scale-scale adaptation measures (e.g., river normalization) and the partially increasing firms′ engagement on collective adaptation indicate a transformative progress on adaptation to floods. However, Jakarta′s regional trajectory still lacks a coordinated engagement by all actors that cover the entire city region. Rather engagement to floods adaptation is guided uncoordinated through different priorities of the actors (e.g., city authorities vs. manufacturing firms). Thus, in order to achieve a full transformation of the regional trajectory in Jakarta the level of coordination has to be increased and novel ways of risk mitigation have to be sought. Furthermore, firms′ initiatives on collective adaptation should be encouraged by state authorities and firms′ solutions should be integrated into the cities′ formal flood risk mitigation strategies.

In Semarang, a change of the trajectory in the future can hardly be presumed. At the moment, the firms are unable to break their organizational routines and rely on their long-term established but insufficient individual adaptation measures. Furthermore, firms′ collective adaptation is only poorly established, for instance, by the tenants in the largest industrial site Genuk. Since the industrial estate managements are unwilling to improve the poor conditions for the entire industrial parks, small groups of firms, for instance, jointly elevated the access roads to their plants. The firms primarily focus on their own benefit, but more effective large-scale collective adaptation (e.g., planting mangroves to prevent coastal erosion) that can reduce the exposure for the entire region is not envisaged. Moreover, the political will of Semarang′s city authority is also limited to improve the severe conditions of ongoing coastal erosion, land subsidence, and increasing events of tidal flooding. Consequently, one needs to assume that the regional trajectory in Semarang will remain in a resistance stage close to a collapse in the mid-term future.

3.5 Conclusions and outlook

The growing impacts from intensifying environmental hazards such as flooding, typhoons, or sea level rise make adaptation essential. While a lot of attention over the recent years has been given to the adaptation of private households or communities, the ways in which firms act as drivers of adaptation are much less understood. This is striking, given that firms have to shoulder the lion′s share of economic impacts from disasters and play a crucial role in the well-being and resilience of entire regions. Developing countries and emerging economies are of particular concern in this context, given that environmental hazards are in these countries coupled with other challenges such as rapid urbanization, low economic profitability, and weak institutional capacities on the part of states and formal institutions. Authorities in many of these countries face difficulties in providing sufficient adaptation, leaving an adaptation vacuum which needs to be filled by firms and other actors. The Indonesian coastal cities Jakarta and Semarang exemplify these challenges, most notably for manufacturing firms. The firms primarily rely on individual adaptation by long-established organizational routines. Collective adaptation can hardly be observed. Poor established regional governance systems and low support by state authorities hamper engagement on collective adaptation particularly.

Until now, little effort has been made to understand decision-making concerning adaptation at the firm level, including aspects such as strategic business decisions in the face of (increasing)

environmental hazards. While valuable insights can be drawn from different theoretical and empirical streams of existing literature, a comprehensive framework with a strong focus on the role of firms as stakeholders in regional adaptation has been still missing. Based on our explorative study in Jakarta and Semarang, the paper proposes a novel conceptual framework on IARD. The objective of the framework is to provide conceptual guidance for the analysis of regional adaptation processes, especially focusing on the role of firms, and the debate and design of policy options to foster successful regional adaptation trajectories. The framework argues that exposure to environmental hazards combined with broader socioeconomic developments act as a trigger of institutional change. Firms, as stakeholders within regional governance systems, and their decision-making under risk and adaptation, are assumed to be a key factor. The concept suggests examining firms′ decision-making with regard to adaptation from two perspectives: First, firms enhance their competitiveness through adaptation by relying on their routines, which are determined by the decision-makers′ risk behavior and the institutional setting. Second, firms act as stakeholders within wider collective adaptation activities together with other stakeholders (regional governance system). Through both strands reconfigured, regional trajectories can be initiated that can have different outcomes, ranging from collapse to resistance, resilience or transformation.

While the presented framework provides a systematization based on existing literature and allowed us to assume potential future regional trajectories on adaptation to floods in Jakarta and Semarang, the implications of firm-driven adaptation processes should be further addressed. Additional steps have to be taken to validate the usefulness of the framework. Comparative case-studies might constitute a useful method. Qualitative approaches, such as interviews with firms′ decision-makers and respective stakeholders as well as the observation of decision-makers′ actions might be a promising way to assess adaptation. Field experiments, including discrete choice scenarios, with firms′ decision-makers as participants can capture the risk behavior and willingness to change regional trajectories. This mixed-methods approach may facilitate a better understanding of adaptive responses and wider socioeconomic development at the regional level in the face of environmental hazards.

Overall, risk-related environmental hazards remain a pressing issue in many developing countries and emerging economies. The success of socioeconomic transition will be determined by whether the countries are able to deal with environmental hazards, i.e., to reduce the risks and to exploit the opportunities resulting from these hazards.

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4 Überschwemmungen und Regionalentwicklung. Die Rolle von Industriebetrieben in Jakarta und Semarang

(Inundation and regional development – the role of manufacturing firms in Jakarta and Semarang)

Neise, T. und J. Revilla Diez (2018): Überschwemmungen und Regionalentwicklung. Die Rolle von Industriebetrieben in Jakarta und Semarang. In: Geographische Rundschau 70(4): 16-21.

Küstenstädte in Indonesien sind extrem von Überschwemmungen betroffen. Dabei verlieren Menschen nicht nur ihr Hab und Gut, sondern oft auch ihren Job, weil ihre Arbeitgeber die Produktion stoppen müssen. Während Sofortmaßnahmen in der Regel auf die Bevölkerung abzielen, werden Betriebe oft sich selbst überlassen. Da der indonesische Staat angesichts der enormen Herausforderungen finanziell und administrativ überfordert ist, stellt sich zunehmend die Frage, ob die Wirtschaft gemeinsam mit staatlichen Einrichtungen, Nichtregierungsorganisationen, der Zivilgesellschaft und der Bevölkerung eine stärkere Rolle bei der Entwicklung nachhaltiger Anpassungsstrategien einnehmen kann. Deshalb geht dieser Beitrag den Fragen nach, wie Industriebetriebe zum einen individuell mit der Gefährdungssituation umgehen und zum anderen ob sich Industriebetriebe bei kollektiven Anpassungsmaßnahmen im Sinne einer partizipatorischen und integrativen Planung beteiligen.

Die präsentierten Ergebnisse basieren auf mehreren Forschungsaufenthalten von März 2015 bis März 2017 bei denen 58 vornehmlich klein- und mittelständischen Industriebetriebe und 13 Experten (z.B. Industrie- und Handelskammer, Stadtplanung und Nichtregierungsorganisationen etc.) in Jakarta und Semarang befragt wurden. Die Feldforschung erfolgte in enger Zusammenarbeit mit dem Indonesian Institute of Science (LIPI).

4.1 Direkte und indirekte Betroffenheit

Industriebetriebe in Jakarta und Semarang liegen vor allem in Küstennähe oder an Flussufern, wo sie einem hohen Flutrisiko ausgesetzt sind (vgl. Abbildung 4-1). Mehrmals im Jahr kommt es zu Überschwemmungen. In Jakarta verursachen Starkregenfälle meistens Flussüberschwemmungen und Sturzfluten. In Semarang treten Fluten vornehmlich durch Gezeitenhochwasser auf (vgl. den Beitrag BOTT et al. in dieser Ausgabe).

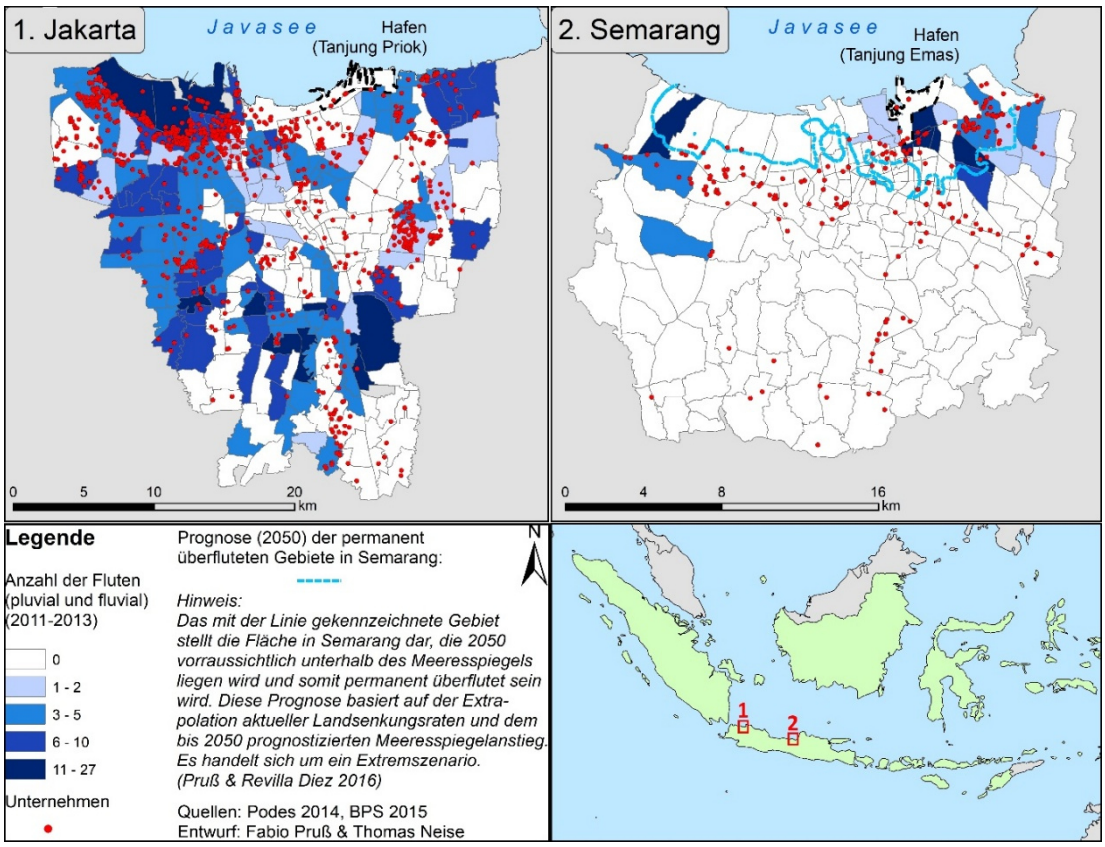

Abbildung 4-1: Standorte von Industriebetrieben in Jakarta und Semarang und ihr Flutrisiko

Typische direkte Flutschäden für Industriebetriebe sind die Zerstörung von Rohmaterialen, Maschinen und Produkten. Im Jahr 2016 entfielen rund 39 % der finanziellen Schäden, die sich insgesamt auf 97 Mio. € aufsummierten, auf Industriebetriebe (vgl. Abbildung 4-2). Da keine langanhaltenden Überschwemmungen auftraten, ist der Wert vergleichsweise gering. Schwere Überflutungen wie 2007 können Verluste von bis zu einer Milliarde Euro verursachen (PETERS et al. 2015). Ein multinationaler Automobilhersteller berichtete, dass aufgrund der schweren Fluten 2007 in Jakarta eine ganze Monatsproduktion von 8000 Mittelklassewagen nicht produziert werden konnte. Weitere zwei Wochen war die Produktion und Auslieferung aufgrund von Reinigungs- und Reparaturarbeiten nur eingeschränkt möglich. Der Schaden betrug ca. 15 Mio. € (INTERVIEW JKT-24 2015).

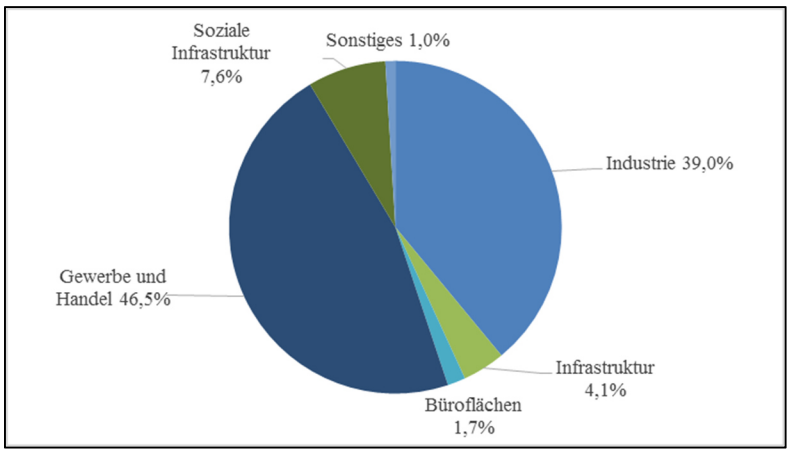

Abbildung 4-2: Finanzielle Schäden durch Überschwemmungen in Jakarta 2016 (Quelle: eigene Berechnung basierend auf JakSAFE 2017)

Neben den direkten finanziellen Verlusten sind Industriebetriebe auch indirekt von Überschwemmungen betroffen. Indirekte Schäden entstehen, wenn die Produktion eingeschränkt werden muss, weil Lieferwege von Roh- oder Endprodukten überflutet sind (HALLEGATTE 2014; vgl. Abbildung 4-3) oder Produktionsanlagen stillstehen, weil die Stromversorgung aus Sicherheitsgründen während Überschwemmungen abgestellt wird. Häufig steht den Betrieben auch nur eine reduzierte Belegschaft zur Verfügung, da die Wohnungen und Anfahrtswege der Mitarbeiter überflutet sind (NEISE et al. 2017).

Abbildung 4-3: Überfluteter Industriepark und Straßenerhöhung in Semarang (Quelle: Javier Revilla Diez)

Indirekte Einschränkungen führen mittel- bis langfristig zu betriebswirtschaftlichen Ausfällen. Viele Betriebe verlieren Aufträge oder müssen Vertragsstrafen zahlen, da sie die vereinbarten

Lieferzeiträume nicht einhalten können (INTERVIEW JKT-21 2015; SMG-21 2016*)*. Unternehmen, die einen ausreichenden finanziellen Puffer haben, können die Verluste zwar auffangen. Der Fortbestand von klein- und mittelständischen Betrieben, die in der Regel über nur sehr geringe finanzielle Handlungsspielräume verfügen, ist aber gefährdet. Beispielsweise sind im größten Industriegebiet von Semarang Genuk Flächen bereits durch Küstenerosion und Landsenkungen permanent überflutet. In der Folge mussten viele Betriebe ihre Mitarbeiter entlassen oder sind sogar bankrottgegangen (FINESSO 2016).

4.2 Individuelle Anpassungsmaßnahmen

Eigene Befragungen ergaben, dass die Betriebe individuelle Anpassungsmaßnahmen ergreifen, um die Risikoanfälligkeit zu reduzieren (vgl. Tab. 4-1). Dabei sind Großbetriebe eher in der Lage weitreichende kostenintensive Maßnahmen durchzuführen. Klein- und Kleinstbetriebe, die ums Überleben kämpfen müssen und deren finanziellen Mittel begrenzt sind, passen sich teilweise gar nicht an bzw. nutzen nur punktuelle Anpassungsformen wie beispielsweise die Installation von Pumpen oder die Erhöhung der Einfahrten (LINNENLUECKE & GRIFFITHS 2015, NEISE et al. 2017).

Aufgrund der langjährigen Erfahrung mit Überschwemmungen besitzen Betriebe üblicherweise Pumpen, um die Produktionsstätten trocken zu legen. Großbetriebe bzw. Industrieparks besitzen zudem Entwässerungskanäle und Rückhaltebecken. Um sich zeitgleich gegenüber Landsenkungen und Überflutungen zu schützen, werden die Produktionsstätten, die Maschinen bzw. die Zufahrtsstraßen höher gelegt. Hierfür wird meist eine weitere Betonschicht (0,5 – 1 m) aufgesetzt. Jedoch reichen diese technischen Lösungen nicht aus. Es sind vielmehr reaktive Lösungen, anstatt präventiv wie zum Beispiel durch die Erweiterung der Flusskapazitäten und die Freihaltung von Retentionsflächen das Flutrisiko zu reduzieren.

Wochenlange Überschwemmungen 2007 und 2012 haben in Jakarta bei mittelgroßen und großen Unternehmen zu einem Umdenken geführt. Technische Anpassungsformen wurden ausgeweitet und mit organisatorischen und sensibilisierenden Maßnahmen ergänzt (siehe Tabelle 4-1). In Semarang sind solche Maßnahmen aufgrund mangelnder finanzieller Mittel nur vereinzelt zu sehen. Schon fast resignierend werden saisonale Überschwemmungen von den Betrieben als „normal“ bezeichnet.

Tabelle 4-1:Individuelle Anpassungsmaßnahmen von Industriebetrieben in Jakarta und Semarang

Formen	Beispiele
Technisch	• Pumpen, Entwässerungskanäle und Rückhaltebecken • Erhöhung von Zufahrtsstraßen, Gebäude(-teilen), Maschinen
Organisatorisch	• Erweiterung von Lagerkapazitäten • Frühere Bestellung und längere Lieferzeiträume • Alternative Lieferrouten, Lieferformen
Sensibilisierend	• Überwachung von Pegelständen und Regenfallprognosen • Katastrophenschutzübungen mit Mitarbeitern • Emergency Response Teams
Räumlich	• Verlagerung von Produktionsstätten

Quelle: eigene Zusammenstellung basierend auf Interviews

In Semarang werden stattdessen häufiger Standortverlagerungen als Anpassungsmaßnahme vorgenommen, da die Infrastruktur der küstennahen Industriegebiete mangelhaft ist. Es existieren keine Abwassersysteme und die Straßen sind nicht flächenweit asphaltiert. In Genuk sind seit 1989 ca. 500 kleine und mittelgroße Betriebe aufgegeben wurden. 50 Betriebe sind in neue und besser ausgestatte Industrieparks im höher gelegenen Süden verlagert worden (FINESSO 2016).

4.3 Reaktion der Regionalplanung

In beiden Städten forcieren die Behörden die Umwidmung von flussnahen Flächen, die durch einen Mix von oftmals informellem Wohnen und Arbeiten geprägt sind, in moderne Stadtviertel mit Einkaufszentren, Büros und Appartementhäusern. Zugleich soll somit die Umweltverschmutzung und das Flutrisiko reduziert werden (INTERVIEWS STADTPLANUNG JAKARTA UND SEMARANG 2017). Allerdings führt diese Strategie zu besonderen Härten. In Jakarta werden durch die Umwidmung Kleinbetriebe von den Flussufern verdrängt und verlieren dadurch ihre Existenzgrundlage. Die Inhaber können es sich nicht leisten, ihren Betrieb an einem anderen Standort wiederaufzubauen. Insbesondere für die ärmere Bevölkerung sind Kleinbetriebe häufig der einzig mögliche Arbeitgeber. Hinzu kommt, dass diese nicht für die Umweltverschmutzung vornehmlich verantwortlich sind. Problematischer sind vielmehr die großflächigen, teilweise neu errichteten Industriegebiete mit hauptsächlich Großbetrieben in der Nähe des Flughafens und des Hafens. Diese Gebiete sind durch den Meeresspiegelanstieg und die hohen Landsenkungsraten von ca. 10 cm pro Jahr (ABIDIN et al. 2011) einem sich verstärkenden Flutrisiko ausgesetzt. Gleichzeitig verschiebt Jakarta das Problem in sein Umland, das allerdings

durch ein ähnlich hohes Flutrisiko gekennzeichnet ist. Letztlich scheint die aktuelle Raumordnungspolitik im Metropolraum Jakarta bezüglich der Standortwahl von Industrien mehr Probleme zu schaffen, als bestehende effektiv zu lösen.

Semarang zeigt eine ähnliche Raumplanung. Durch Suburbanisierung werden neue Risikogebiete geschaffen. Industrieparks werden im hügeligen Süden bzw. in ehemaligen Mangrovenflächen an der Küste errichtet. Allerdings sind die langfristigen naturräumlichen Konsequenzen, wie Hangrutsche oder neue Flutrisikogebiete, nur unzureichend raumplanerisch berücksichtigt (HANDAYANI & RUDIARTO 2014). Trotz dieser Risiken wird der Suburbanisierungsprozess behördlicherseits forciert. Flutexponierte Gebiete wie Genuk werden zeitgleich ihrem Schicksal überlassen. Perspektivisch verspricht die Stadtverwaltung, das Flutrisiko durch Erweiterungen des Flutkanals, Renaturierung sowie Umwandlung in Büro- und Wohngebiet zu reduzieren (INTERVIEW STADTPLANUNG SEMARANG 2017). Allerdings ist es fraglich, ob der fortlaufende Prozess von Küstenerosion durch den Meeresspiegelanstieg und der Landsenkungen noch gestoppt werden kann (vgl. den Beitrag *Bott* et al. in dieser Ausgabe). Wahrscheinlich ist eher, dass das gesamte Gebiet permanent überflutet wird. Auch die letzten Betriebe werden abwandern bzw. schließen müssen. Hierdurch werden Arbeitsplätze abgebaut und neue Flächenversieglungen werden durch die Schaffung von Ersatzflächen vorgenommen.

4.4 Kollektive Anpassungen als Lösung?

Die eigenen Interviews zeigen, dass individuelle Anpassungsmaßnahmen der Industriebetriebe und staatliche Raumplanung in beiden Städten nicht im Einklang stattfinden, um entscheidend das Flutrisiko zu senken. Die Flutanpassung erscheint ineffektiv, da sie unkoordiniert nebeneinander durchgeführt wird. Die individuellen Anpassungen (z. B. eigene Pumpen) der Betriebe zeigen, dass diese nicht ausreichen, um das Flutrisiko langfristig zu reduzieren. Weitere Investitionen in stadtteilumfassende Pumpanlagen, in Straßen- und Gebäudeerhöhungen oder für Standortverlagerungen müssen vorgenommen werden (z.B. INTERVIEWS JKT-20, 2015, SMG-12, 2016). Zeitgleich sind die städtischen Behörden mit den immensen Investitionen in Flutschutzmaßnahmen überfordert. Mit Hilfe von internationalen Darlehen und Expertise führen die Stadtverwaltungen zwar großangelegte Flussbegradigungen durch oder bauen Küstendeiche (INTERVIEW STADTPLANUNG SEMARANG, 2017, INTERVIEW FLUTMANAGEMENTAGENTUR JAKARTA, 2017). Jedoch zielen diese Maßnahmen vielmehr auf Wohn- und Bürogebiete ab bzw. ist ihre großräumliche Effektivität begrenzt.

Vor diesem Hintergrund stellt sich die Frage, ob nicht kollektive Anpassungsstrategien zu einer effektiveren Flutrisikoreduktion führen könnten. Angesichts der finanziellen Möglichkeiten und ihrem Know-how wären Industriebetriebe in der Lage, größer angelegte Flutreduktionsmaßnahmen wie Rückhalteflächen oder große Pumpanlagen finanziell und personell mit zu unterstützen und somit für eine Entlastung des Staates sorgen. Die Betriebe sollten daran zunächst ein Eigeninteresse haben. Sie verbessern damit ihre eigene Wettbewerbsfähigkeit, da somit zum Beispiel die Lieferwege nicht mehr durch Überschwemmungen unterbrochen sind. Weitreichendere Anpassungsmaßnahmen wirken sich nicht nur positiv auf die Reduktion des Flutrisikos bei den Betrieben, sondern auch bei den Bewohnern aus, die oft in unmittelbarer Nachbarschaft zu den Industriebetrieben leben. Ganzheitlich verbessert sich die städtische Infrastruktur und es entstehen effektivere Flutanpassungsmaßnahmen, so dass Betriebe weiterhin als wichtiger lokaler Arbeitgeber und Steuerzahler vor Ort bleiben (LINNENLUECKE & GRIFFITHS, 2015; NEISE et al., 2017).

Grundsätzlich beteiligen sich Industriebetriebe an kollektiven Maßnahmen; allerdings häufig nur bei Notsituationen. Die Betriebe spenden Geld, Medikamente oder Nahrungsmittel bzw. bieten ihre Produktionsstätten als Notfallquartier an. Zudem stellen Betriebe Mitarbeiter ab, um mit den Bewohnern gemeinschaftlich die verstopften Flüsse und Abwasserkanäle zu reinigen, um damit lokalen Überschwemmungen bei starken Regenfällen vorzubeugen *(*z.B. INTERVIEWS JKT-5; 11; 12, 2015; SMG-10, 2016*)*.

Tabelle 4-2: Kollektive Anpassungsmaßnahmen mit Beteiligung von Industriebetrieben in Jakarta und Semarang

Formen	**Beispiele**
Technisch	• Erhöhung von Hauptstraßen • Errichtung von Deichen, Retentionsflächen • Pumpsysteme / -häuser
Organisatorisch	• Reinigung von Flüssen, verstopfter Abflüsse (gemeinnützige Arbeit von Mitarbeitern) • Informationskampagnen für Bürger
Karitativ	• Geldspenden, Verteilen von Nahrungsmitteln, Medikamenten, Decken etc. • Produktionsstätten als Notquartier bereitgestellt

Quelle: eigene Zusammenstellung basierend auf Interviews

Großangelegte infrastrukturelle Flutreduktionsmaßnahmen unter der Beteiligung von Industriebetrieben existieren jedoch bislang nur vereinzelt. Ein Beispiel ist in Ost-Jakarta vorzufinden. Großbetriebe und Anwohner haben sich auf die Errichtung größerer Pumpsysteme und

dem Bau eines Entwässerungskanals verständigt, welcher die Wassermassen nach starken Regenfällen in den nahe gelegenen östlichen Flutkanal leiten soll. Die Betriebe werden die Maßnahmen finanzieren und ausführen. Obwohl sich die Unternehmen und Anwohner einig waren, hat sich das Projekt jahrelang verzögert, da die Stadtverwaltung nicht die Baugenehmigungen erteilen wollte. Seit dem Frühjahr 2016 werden die Bauarbeiten endlich ausgeführt (INTERVIEW JKT-9, 2015). In Ost-Semarang haben sich Bewohner und Betriebe zu einem Aktionsbündnis zusammengeschlossen. Gemeinsam wollen sie den Bau und Instandhaltung mehrerer Rückhaltebecken und Pumphäuser durch lokale Abgaben aller Anwohner und Betriebe finanzieren. Bislang ist das Projekt nicht gestartet, da die Stadt die eigenen Flächen nicht für die Rückhaltebecken zur Verfügung stellen will (INTERVIEW SMG-28, 2016).

Leider bleiben solche Initiativen in beiden Städten die Ausnahme. Viele Betriebe sind der Meinung, dass die staatlichen Organe in der alleinigen Verantwortung sind, öffentliche Infrastruktur zu finanzieren und bereitzustellen. Von den Unternehmen werden zugleich die mangelnde Kooperation und die Unzuverlässigkeit von staatlichen Behörden bemängelt. Korruption und die komplizierten Genehmigungsverfahren behindern kollektive Initiativen. Darüber hinaus sind vor allem Großbetriebe bei ihrem weiteren Engagement zurückhaltend, da sie bereits sog. Kompensationen leisten müssen, welche die Behörden beispielsweise für Baugenehmigungen fordern (INTERVIEW JKT-17, 2015). Vertreter der lokalen Raumplanungsbehörden von Jakarta und Semarang äußerten während der Interviews, dass sie durchaus Unterstützung begrüßen. Jedoch lassen die derzeitigen Gesetze keine Ko-Finanzierung durch private Akteure zu.

4.5 Ausblick

Auch wenn beim Flutschutz verstärkte Anstrengungen von Betrieben und der Stadtverwaltung in Jakarta und in geringerem Umfang in Semarang zu erkennen sind, läuft zeitgleich die Raumplanung den Zielen eines reduzierten Flutrisikos und einer integrativen anpassenden Regionalentwicklung entgegen. Es zeigt sich, dass in beiden Städten bislang kein umfassender kollektiver Ansatz bei der Flutanpassung existiert. Die Betriebe fokussieren sich vielmehr auf ihre individuellen Anpassungen. Mangelndes Vertrauen in die staatlichen Behörden und die geringe Kooperationsbereitschaft der Stadtverwaltungen begrenzen kollektive Initiativen. Gemeinsame Anstrengungen und die Eindämmung einer zunehmenden Zersiedelung sind jedoch fundamentale Maßnahmen, um langfristig das Flutrisiko zu reduzieren. Entwicklungen, wie in Genuk, wo Küstenerosion und Landsenkungen zu immer mehr betrieblichen Konsequenzen, bis hin

zum Bankrott, führen, sind ein warnendes Beispiel. Sowohl die Wettbewerbsfähigkeit der Betriebe als auch sozioökonomische Bedingungen der Bewohner (Arbeitsplatzverlust, Unbewohnbarkeit) sind gefährdet. Die derzeitigen Entwicklungen von fortschreitender Landsenkungen, Meeresspiegelanstieg und Flächenversiegelung durch ausweitende Urbanisierungsprozesse werden das Flutrisiko eher erhöhen als reduzieren. Ähnliche Entwicklungen sind nicht nur in den Küstenstädten Javas zu sehen, sondern auch die anderen großen Inseln des flutexponierten Archipels Indonesien sind davon vermehrt betroffen.

Summary

Inundation and regional development – the role of manufacturing firms in Jakarta and Semarang

Manufacturing firms are primarily concentrated in coastal cities like Jakarta and Semarang, where they are affected by floods. Firms are trying to adapt individually to the floods and engage partly on collective adaptation efforts like the construction of large pump systems. Also, city authorities are attempting to reduce the flood risk with international support. However, coordinated collective flood adaptation plans cannot be observed, yet. Spatial planning is driving further urbanization but without initiating a dialogue between different stakeholders and thus impeding the firms′ engagement in collective flood adaptation. Consequently, the risk of inundation might be increasing due to continuing land subsidence, sea level rise and land sealing. This development does not happen only in Javanese coastal cities but also on the other flood-prone big islands of Indonesia. In sum, joint efforts on flood risk reduction and a more integrated regional development is strongly needed.

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5 Adapt, move or surrender? Firms′ routines and dynamic capabilities on flood risk reduction in coastal cities of Indonesia

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Abstract:

Many manufacturing firms collocate within coastal urban areas in Indonesia. At these locations, they are severely affected by the most occurring environmental hazard, floods. Although research on firms′ adaptation to environmental hazards is burgeoning, the focus still lies on damage evaluation, support for disaster relief, or on how firms can support the community. Despite the fact that floods are a recurrent and aggravating stressor for firms, particularly in developing countries, a clear understanding of how firms develop adaptation strategies and which rationales determine their strategy has been sparsely addressed. Therefore, this paper derives flood adaptation strategies from the literature and empirically test them on flood-prone manufacturing firms in Jakarta and Semarang. Based on 67 in-depth interviews, we demonstrate that firms′ routines (i.e., behavioral pattern) and dynamic capabilities (i.e., competencies) determine the adaptation strategies of manufacturing firms in Jakarta and Semarang. The study shows that firms′ flood adaptation strategies differ regarding business size and between both cities. Particularly, it is detected that large and medium-sized firms can adapt more effectively to floods, while small firms face difficulties due to inferior routines and dynamic capabilities. This shortcoming jeopardizes their general business viability. Overall, the paper emphasizes the imperative for a deeper understanding of firms′ adaptation strategies since viable firms are an essential player to strengthen the social welfare, economic development, and ecological conservation in flood-prone areas.

Keywords: adaptation, manufacturing firms, flood, routines, Indonesia

5.1 Introduction

When Thailand experienced devastating floods in 2011, the entire economy faced huge economic losses (41 Billion US-$). With a share of 71 % of the total losses, manufacturing firms suffered the most and took more than one month to resume the operation (HARAGUCHI & LALL, 2015). Besides, this extreme example floods are typically a recurrent environmental hazard that disrupts the operation of manufacturing firms in Southeast Asian coastal cities. The businesses suffer, for instance, from destroyed raw materials and machinery, power outages, and supply-chain disruptions that affect their competitiveness (HALLEGATTE, 2014). Thus, manufacturing firms have a high need to handle and alleviate the harm by floods effectively. These adaptation measures include immediate responses to resume the operation rapidly after flood events and to find ways of long-term adaptation measures to alleviate the flood risk (ADGER et al., 2005; PELLING, 2011; WILBANKS, 2007).

In Indonesia, the manufacturing sector is a crucial player to alleviate poverty and provide jobs for the increasing population. Centers of the manufacturing sector are typically coastal cities, e.g., Jakarta, Surabaya, and Semarang (WORLD BANK, 2012). At the same time, the coastal cities are constantly affected by sea-level rise, land subsidence, coastal erosion, and high rainfall rates. The interaction of these environmental hazards along with urban expansion and land-use change aggravates the flood risk of manufacturing firms (FUCHS et al., 2011; NEISE et al., 2018). Regarding Jakarta and Semarang the flood risk for manufacturing firms will likely increase. A study by Budiyono et al. (2016) estimated that one-third of the entire flood damages in Jakarta have to be shouldered by the industry sector and will increase to 47 % in 2030. Similarly, a recent study on the risk of tidal inundation in Semarang states that more parts of settlement areas with small enterprises and industrial areas will be affected by tidal inundation (BUCHORI et al., 2018). Due to this high exposure to floods manufacturing firms in both cities need to adapt to reduce their output losses, and the loss of employment, livelihoods and tax revenues for the entire regional economy.

Due to this prominent role of firms in exposure to environmental hazards, respective research is burgeoning. This research mostly concentrates on losses or damage, survival rates (e.g., BAHINIPATI et al., 2017; PATHAK & AHMAD, 2016), and the recovery time of firms (e.g., DE MEL et al., 2011). However, less attention is paid to how firms can reduce their exposure or what they have learned from the hazard event and what efforts they have put into risk reduction measures. Literature indicates that larger and foreign firms can respond faster to flood events than small and medium-sized firms (SMEs). SMEs often lack effective flood adaptation strategies (e.g. IRP, 2016; KATO & CHAROENRAT, 2018). So far, research is sparse on comparing large firms and SMEs and deciphers the rationales whether and why firms with different business size adapt differently.

Lately, a research focus aligned with concepts from organizational and management studies has emerged. These studies address how firms establish adaptation strategies to respond to climate change impact and sustain business continuity (e.g., BERKHOUT et al., 2006; BUSCH, 2011). The studies provide a broad range of case studies, for instance on the electric, oil and gas industry (e.g., BUSCH, 2011; GASBARRO & PINKSE, 2016) and salient conceptual ideas, such as routines and dynamic capabilities (e.g,. NELSON & WINTER, 1982; TEECE et al., 1997). However, the literature puts less attention to understand how manufacturing firms in developing

countries, in particular, respond to permanent stress from floods. This provides a striking research gap since manufacturing firms in developing countries are largely affected by floods. Hence, failed or ineffective adaptation to floods also jeopardizes the firms′ viability.

Therefore, this paper aims to complement the literature on firms′ organizational adaptation (cf. BUSCH, 2011; TEECE et al., 1997) in the context of floods. The study endeavors to elaborate which competencies and resources firms utilize to adapt to floods and whether there are differences between firms with regard to their business size. In doing so, we refer to existing typologies (e.g., BUSCH, 2011; GASBARRO & PINKSE, 2016) and contextualized them with literature on the impact of flood exposure on manufacturing firms. Consequently, the paper contributes to the literature with a profound typology of flood adaptation strategies. This conceptualization is applied to flood-affected manufacturing firms in Jakarta and Semarang.

Section 2 provides the theoretical considerations of our typology of firms′ flood adaptation strategies. Section 3 presents a background of flood exposure in Jakarta and Semarang. Section 4 describes the method and the data. Findings are presented and discussed in section 5. The paper concludes with a summary and outlook.

5.2 Firms′ flood adaptation strategies

5.2.1 Firms′ routines and dynamic capabilities

For decades, organization and management studies have been interested in how firms adapt to changing environments. However, the recent overview by Daddi et al. (2018) shows that a strong theoretical contribution with regard to climate change studies on corporate strategies is lacking. Besides corporate social responsibility approaches and behavioral economic concepts, approaches on strategic management (e.g., organizational learning, and dynamic capabilities) are dominant theoretical concepts in the debate. The latter are predominately applied from a firm perspective and their strategies toward climate change impact (DADDI et al., 2018), but immediate exposure, for instance, to floods has been less addressed in the discussion so far.

Given this gap, we derive a typology of flood adaptation strategies in order to examine how firms are able to reduce their flood-induced business disruptions. The typology is based on the dynamic capabilities framework (cf. TEECE et al., 1997) and the idea of routines (cf. NELSON & WINTER, 1982). Routines are interpreted as stored regular and predictable behavioral patterns (e.g., standard operating procedures, organizational and spatial flexibilities) and describe how

firms exert their typical business activities in ordinary situations (BERKHOUT et al., 2006; NELSON & WINTER, 1982; ZOLLO & WINTER, 2002). Dynamic capabilities become important when firms face rapid, unpredictable changes and market dynamics that oftentimes require a novel conceptualization of routines (NELSON & WINTER, 1982; ZOLLO & WINTER, 2002). They are understood as higher level competencies (e.g., skills, knowledge, and technologies) that enable firms to integrate, develop, and reconfigure internal and external resources and routines to address changing business situations (TEECE et al., 1997). Typically, dynamic capabilities result from organizational learning, i.e., firms′ systematic processes to modify operating routines (ZOLLO & WINTER, 2002). Accordingly, we understand adaptation strategies as the continuous, path-dependent utilization of routines and resources that comprise actions and measures that enable an effective response to hazard exposure (ADGER et al. 2005; STABER & SYDOW, 2002). Thereby, adaptation strategies can have a short-term character that yields to respond to occurring flood events (e.g., protect the plant by sand sacks or pumps). In order to alleviate more substantially the flood risk and prevent the production plants from flood impacts, adaptation strategies are part of a long-term investment plan (e.g., the construction of dike and canal system) (GARSCHAGEN, 2014; PELLING, 2011). If the efficacy of routines is under- or overassessed or the firm possesses inadequate dynamic capabilities (BARNETT & O'NEILL, 2010; GROTHMANN & PATT, 2005), it may cause maladaptation. This entails failed or avoided responses that may increase the susceptibility of firms to floods. Consequently, maladaptation can lead to decreasing competitiveness (LINNENLUECKE et al., 2011; NEISE et al., 2018).

5.2.2 Typology of flood adaptation strategies

Based on the concepts of dynamic capabilities and routines and respective conceptual and empirical research (e.g., BERKHOUT et al., 2006; BUSCH, 2011; GASBARRO & PINKSE, 2016; LINNENLUECKE & GRIFFITHS, 2015) six types of flood adaptation strategies are derived. Since this research rather focusses not on the manufacturing industry, but, for instance, on the oil and gas or electrical power industry within the context of climate change our typology considers especially the contextual factors of flood exposure in a developing country such as Indonesia.

(1) *Proactive adaptation strategy*: In literature, proactive adaptation has become the common understanding of adaptation, as a more deliberate, continuously and coordinated action over longer time-frames (GARSCHAGEN, 2014). Concerning firm′s adaptation strategy, a firm anticipates possible future flood hazards. Flood risk is aimed to be reduced through the imple-

mentation of long-term planned adaptation measures such as early warning systems or business continuity planning (ADGER et al., 2005; BUSCH, 2011; LINNENLUECKE & GRIFFITHS, 2015). Business continuity means the firm is still capable of delivering products despite a flood event (MCKNIGHT & LINNENLUECKE, 2016). Similar to Gasbarro and Pinkse (2016), it is suggested that firms assess a high firm-specific impact and local exposure from floods that affect their financial and physical assets (e.g., machinery). Busch (2011) claims that firms absorb knowledge about future disruptions by environmental hazards, for instance, through forecasting and monitoring systems or attending workshops. This gained knowledge is crucial to establish adaptation measures that consider the future impacts on business operations. Consequently, the firms with a proactive strategy establish competencies, for instance, sophisticated knowledge of risk identification, assessment, and mitigation. Therefore, it is assumed that former high losses due to a flood catastrophe can provoke the firm to intensifies their utilization of competencies and resources toward a proactive adaptation strategy (GASBARRO & PINKSE, 2016). This will commonly include a high investment of financial, technological, and organizational assets in order to implement broader measures (e.g., early warning systems, larger capacities of pumps or a water basin) (ARAGÓN-CORREA & SHARMA, 2003). Hence, it is assumed that mainly medium-sized and large firms with a high level of competitiveness and sufficient resources are able to follow a proactive adaptation strategy. Proactivity is also understood to be a firm adopting or continually modifying their routines if their former response was evaluated as inadequate. Due to their sophisticated competencies, the firms are able to strengthen or adopt new knowledge, skills, and technologies that enable lower exposure to floods (ARAGÓN-CORREA & SHARMA, 2003; TEECE et al., 1997).

(2) *Relocation strategy*: This strategy is seen as the most drastic option to lower flood exposure. Since relocation requires high investment, it is plausible that firms plan to relocate if other adaptation options are not practicable or have been proven as ineffective (LINNENLUECKE et al., 2011). Flood catastrophes that have caused high losses or increasing continual harm from floods, land subsidence, and coastal erosion might push firms to relocate. The firm realizes that in-situ adaptation is not the optimal option because the flood exposure is too severe and endangers the viability of the firm (LINNENLUECKE & GRIFFITHS, 2015). For instance, during the large Thailand floods 2011 Toshiba moved their production temporarily to the Philippines (HARAGUCHI & LALL, 2015; for other examples see LINNENLUECKE et al., 2011). Locational disadvantages (e.g., poor infrastructure, high labor costs), expansion plans, and the use of ubiquitous resources might encourage the relocation decision. High

competitive pressure that does not allow production or delivery to be halted over a long period might also initiate relocation (LINNENLUECKE et al., 2011). This indicates that a firm with sophisticated dynamic capabilities (e.g., financial resources, flexibility, and risk anticipation ability) is able to relocate. Hence, it is assumed that mainly large domestic and less locally embedded foreign firms with a high level of competitiveness and/or exporting activities might consider relocating.

(3) *Reactive adaptation strategy:* A firm reacts with short-term responses to the consequences of a flood event when it is taking place (BUSCH, 2011). The reactive strategy aims to achieve stability that is known in the literature as resistance or coping, i.e., a short-term response to hazard impacts (GARSCHAGEN, 2014; HANDMER & DOVERS, 1996). In contrast to the former types, the business impact might be not perceived as severe (e.g., tidal inundation). The firm relies on its established routines and tries to strengthen its status quo. Firms have developed tailored competencies for a specific (recurring) hazard event but will have difficulty adopting these competencies toward changing pattern of flood events. Or, the firms face difficulty to predict the occurrence of floods or/and the potential of future damages, even though the firms are aware of increasing exposure (GASBARRO & PINKSE, 2016). Their dynamic capabilities are relatively inflexible which obstructs adapting to dynamic changes in environmental hazards. In accordance with Gasbarro and Pinkse (2016), it is assumed that business planning is short on long-term planning, especially with regard to business risks. Accordingly, the firm responds to flood events by continuing their established adaptation measures, or more resources are invested in order to enhance these (e.g., more pump capacities). Reactive adaptation bears the risk that measures insufficiently address exposure, or the exposure is just shifted so that the risk may be aggravated in the future. This can jeopardize the survival of the business (ABBAS et al., 2015; ADGER et al., 2005). It is assumed that rather domestic small and medium-sized enterprises (SMEs) with a small margin pursue a reactive strategy. With their limited revenues, firms hesitate to invest their scarce resources in flood adaptation. Moreover, the firms might not be able to develop more knowledge and skills because the scarce resources will instead be invested in sustaining business development.

(4) *Surrendering strategy*: Lacking appropriate competencies and resources (e.g., limited funding or skills) make it difficult for a firm to adapt or individual adaptation measures are considered ineffective. This behavior is also called a ‘wait-and-see’-strategy (BERKHOUT et al., 2006). Adaptation is postponed or not undertaken due to the firm′s inabilities. We assume that a surrendering strategy is especially pursued by SMEs because they are oftentimes overburdened with the simultaneous challenge from floods and other external

factors (e.g., strong competition). Formerly failed adaptation can also cause a firm to surrender because the firm is unwilling or unable to enhance its dynamic capabilities. Therefore, the firm follows a maladaptation. It is also possible that firms tolerate losses rather than invest in adaptation measures (AGRAWALA et al., 2011). Finally, a surrendering strategy and the severe impact of exposure to floods can slightly lower the firm′s competitiveness.

These proposed strategies focus on the pure firms′ individual adaptations. The last two types involve external stakeholders (e.g., state authorities, community, or neighboring firms) that are not in a direct business relationship with the flood-affected firm. However, the firm relies on the effort of the external stakeholders to adapt to floods.

(5) *Depending strategy:* A firm counts on large-scale (public) adaptation measures initiated by state authorities (e.g., a dike system) or by NGOs (e.g., donations, loans to cover losses). Individual adaptation is just done to a small extent (e.g., a pump) or is not implemented. In the context of many developing countries, state authorities are often overburdened with the simultaneous need to provide adaptation measures to environmental hazards and public infrastructure, such as road infrastructure, sanitation, and education facilities (NEISE et al., 2018). Therefore, the firm puts its viability in the hands of external actors that might also not be interested in supporting the firm. As a consequence, the depending strategy might be a risky strategy and, consequently, a typical example of maladaptation.

(6) *Collaboration strategy*: The firm realizes that individual adaptation measures are inadequate to reduce exposure to floods that have a local or regional character (e.g., coastal erosion). Or the firm prefers to integrate their competencies and resources into collaborations with other firms, the community, or state authorities on large-scale flood adaptation that can more efficiently reduce the flood risk for everyone. This strategy addresses the idea of collective adaptation where firms jointly with other actors attempt to reduce the local exposure to floods. Berkhout et al. (2006) also argue that cooperation might be necessary to implement effective adaptation. In this context, firms need to overcome their self-interest and have to show their willingness to invest or share their own routines so that the entire neighborhood can benefit. Although this collaboration can be a win-win strategy for the firm and their neighboring firms and/or residents, it can also cause free-riding. Uncooperative actors seek to benefit from others′ efforts to provide flood adaptation for the entire neighborhood (NEISE et al., 2018; OSTROM, 2000).

Overall, it is assumed that no clear delimitations between the different flood adaptation strategies exist. Rather, it is plausible that manufacturing firms pursue more than one strategy in order to find their best option for their business and their flood exposure. Moreover, it might be possible that former inappropriate outcomes of former pursued strategy lead to the choice of another strategy. For instance, relocation can be either a result of a suboptimal reactive strategy or a stronger consequence of a proactive strategy. In general, there might be shifts of pursued flood adaptation strategy. The choice of flood adaptation strategy can be dynamic, for instance, due to aggravating flood risk or changes in the business development. Consequently, the empirical investigation aims to provide more clarity on how the flood adaptation strategies are connected and whether the firms change their pursued strategy.

5.3 Flood exposure in Jakarta and Semarang

For the enquiry two highly flood-prone coastal cities, namely Jakarta and Semarang with a high density of manufacturing firms were selected. In Jakarta, urban expansion, reduction of mangroves and deforestation in the mountainous hinterland as well as narrowed river arms have made floods a pressing threat (FIRMAN et al., 2011; VAN'T KLOOSTER et al., 2012). Two kinds of floods expose Jakarta and consequently, the manufacturing firms located in this city: The coastal area is mainly affected by tidal inundation because large parts are below the sea-level. Land subsidence (per average 4 cm per year) further exacerbates the risk of tidal inundation (ABIDIN et al., 2011). Fluvial floods (i.e., riverine inundation) frequently occur during the monsoon season (November – March) nearby the thirteen rivers and the myriads of canals. Pluvial floods (i.e., surface inundation) happen especially in the rainy season due to clogged waterways, vanished catchment areas and sealed land that reduces the rainwater absorption (FIRMAN et al., 2011; SAGALA et al., 2013). Severe flooding has roughly occurred once every five years (e.g., 2002 and 2007), but recently large-scale inundations occur more frequently, for instance in 2013 and 2014. Furthermore, the city faces minor floods several times per year (JAKSAFE, 2018).

Similarly, for about one decade Semarang is expanding rapidly. Former green coastal areas have been converted into commercial, residential and industrial areas. The majority of industrial and commercial areas is located on low lying coastal floodplains with a maximum elevation of 10 m above the sea-level. Particularly the highly populated northern part at the coast shows high rates of land subsidence (per average 7 cm per year) due to natural compaction of the young alluvium soil, which is strongly enhanced by extensive urbanization and excessive

groundwater extraction. That accelerates the risk of tidal inundation (HARWITASARI & VAN AST, 2011; LUBIS et al., 2011; MARFAI & KING, 2008).

Besides the risk of tidal inundation, pluvial and fluvial flooding frequently occurs as the settlements lying lower than the waterways. Tidal inundation also takes place more frequently and lasts longer. Generally, the mostly low-level inundation is not threatening human lives or firms′ viability, but it is rather a frequent disruption that might result in firms′ closure in the long-run. For instance, the salty sea water damages buildings and critical infrastructure (HARWITASARI & VAN AST, 2011; LUBIS et al., 2011). However, land subsidence and coastal erosion are continuing, and for instance, in the western part of the city, parts of the former agriculture and industrial land are vanishing permanently and becoming uninhabitable (BUCHORI et al., 2018).

5.4 Method and data

The investigation applied an explanatory case-study approach (cf. YIN, 2014). In a first phase selected representatives of manufacturing firms and experts in public agencies (e.g., spatial planning and disaster management agency) and business associations were interviewed. The interviews revealed that manufacturing firms are often left alone from state authorities, and there are diverse flood adaptation strategies regarding the business size and between different locations. Furthermore, the interviews gave a hint that these differences can be explained through the firms′ endowment of financial resources and their competencies. Based on these insights, the subsequent in-depth interviews aimed to decipher the competencies and resources (i.e., routines and dynamic capabilities) of firms of different business sizes and investment forms as well as in different locations. This allowed us to review in more detail firms′ attempts on adaptation and assign them to the proposed flood adaptation strategy types. The enquiry took place in flood-prone districts with a high concentration of manufacturing firms in Jakarta and Semarang. Figure 5-1 displays the chosen districts.

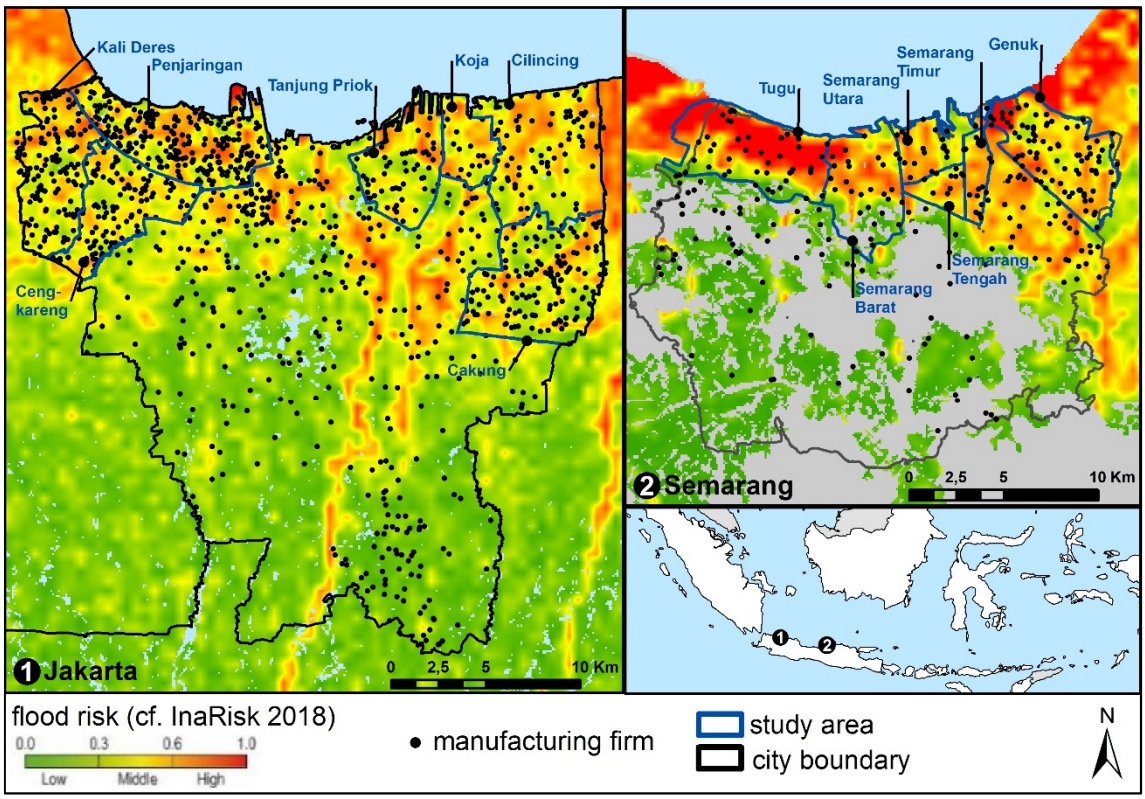

Figure 5-1: Case study areas in Jakarta and Semarang (Design: Thomas Neise)

We conducted semi-structured interviews with 67 decision-makers from flood-affected manufacturing firms between October 2015 and November 2016. The choice of the firms was based on purposive sampling. SMEs and large companies were selected differently. Data about the number of manufacturing firms with less than 20 employees in each sub-district, provided by the 'Village Potential Survey' (BPS, 2015b) was joined with the number of manufacturing firms with a number of employees between 21 and 249 based on the 'Manufacturing Industry Directory 2015' (BPS, 2015a). Based on this analysis, sub-district with a high density of manufacturing firms were chosen. Within this sub-district, firms were selected randomly. The selection of large companies was based on the 'Manufacturing Industry Directory 2015' (BPS, 2015a). Due to the low number, all firms within the selected districts were contacted via telephone and/or request letter. Before starting the interviews, suitable respondents were asked beforehand, whether they had experienced a flood in the last ten years.

We continued the interviewees until we reached a substantial number of different firms regarding size and business origin as well as no novel information could be gathered. Since we were interested to compare the flood adaptation strategies of firms a substantial number of each type of business size and business origin was required. Therefore, the number of medium-sized and large firms overrepresents the real percentage of those types.

The composition of the manufacturing sector is very similar in Jakarta and Semarang. In both cities, about 94 % of the firms are small, while 1.9 % in Jakarta and 2.6 % in Semarang are large firms. In Jakarta, 9.5 % of all firms with more than 20 employees are foreign. The share of foreign firms is 14.9 % in Semarang (BPS, 2017). Tables 5-1 and 5-2 present the sample.

Table 5-1: Overview business size of interviewed firms

Business size	Jakarta	Semarang
Small (less than 50 employees)	14	13
Medium-sized (less than 250 employees)	8	13
Large (250 employees and more)	11	8
Total	**33**	**34**

Source: Authors

Table 5-2: Overview business origin of interviewed firms

Origin	Jakarta	Semarang
Domestic	27	27
Foreign	5	5
Joint-Venture	1	2
Total	**33**	**34**

Source: Authors

In Jakarta, most of the interviewed firms work in the food-processing, metal products, garment, and automotive sectors. The firms in Semarang were mostly active in the food-processing, furniture, and pharmaceutical sectors.

We interviewed firms′ representatives who had the best knowledge about business disruptions and the firms′ corporate strategies. Accordingly, the interviewees were the business owner or director. Occasionally, the division leader for environmental and security issues was interviewed or joined the interview. The interviews centered on the occurrence of flood events and their business impact. We collected the implemented or planned adaptation measures. The interviewees explained their typical response procedures (i.e., routines) their firms pursued when the plant was affected by floods. We asked whether and how these procedures have changed probably as a result of flood events experienced. We collected the involved business divisions′ response procedures, the training programs of the employees, and how many resources are deployed for adaptation. This allowed us to assess whether the firms maintain or continually renew their routines. If firms had difficulty in implementing adaptation measures, we asked the interviewees which lacking assets were the reason. Generally, cooperation with other firms, NGOs, or state authorities and the firms′ overall business development were discussed.

The interview material was analyzed through a structured qualitative content analysis (cf. MAYRING, 2015). At first, indicators based on the conceptual framework were developed, and key examples of each flood adaptation strategy were identified (cf. Table 5-3). After that, the material was deeper analyzed in accordance with the examples and indicators. For each firm, at least one (sometimes two) flood adaptation strategies could be assigned, and the rationale were coded in order to yield deep insights into the pursued flood adaptation strategies. Finally, the gathered data was investigated in order to identify similar patterns or dissimilarities among the firms grouped by each flood adaptation strategy.

Table 5-3: Indicators and examples of content analysis

Type	Indicators	Examples
Proactive	• Former flood event acts as trigger • Anticipation of future flood risk • Modification of routines or developing new competencies/routines (e.g., knowledge of risk assessment and mitigation) • High investment of technological, organizational assets and financial resources on long-term measures	• "We built our own dam as high as 3 meters after 2012 incident. And we enlarged the capacity of our water reservoirs behind this building after 2005." (JDL-6) • "We have a Disaster Recovery Center in order to improve our anticipation, […]. We conduct a risk assessment […]. The result decides what the next step that should be done by the company. So, that's very important." (JDL-2) • "We have rob [i.e., tidal inundation] schedule from BMKG. Every month we ask the BMKG regarding rob or flood prediction. So, we already know when the water level will be higher." (SFM-2)
Relocating	• Former flood event acts as trigger • Giving up in-situ measures • Locational disadvantages, expansion plans or competitive pressure • Sufficient financial resources	• "The consideration to move is just because of floods every year and land subsidence." (SFM-2) • "In our former area, we were so often exposed to flood. […] we could not expand anymore. We saw this as a big burden, costly, of course, wasting money and also our time; that's why we decided to move." (SDL-5)
Reactive	• Responding to occurring flood events when taking place • Continual harm by floods • Relying or more investment on established adaptation measures	• "The solution is just to make the capacity of the pumps larger than now." (SDM-3) • "Because of land subsidence, so probably it is going to be worst. We cannot avoid them. So, the plan is uplifting the building and add more pumps. […] But actually, pumps are not enough. […] I realize this pump strategy maybe can hold the flood only until two years." (SDS-4)
Surrendering	• Severe flood catastrophes or continual harm or tolerating losses • Lacking competencies and resources • No measures or 'wait-and-see'-strategy	• "We didn't have any solution. We could only wait until the flood recedes." (JDS-4) • "He is frustrated. He doesn't want to do anything. He only thinks about how to survive in

		this area without immolating the employees." (SDL-2)
Collaborating	• Harm that cannot be reduced on their own • Willingness to integrate own competencies or resources into collaborations • Provision of public flood-protecting infrastructure (e.g., pump house) jointly with other actors	• "When we built the street, we were offering our neighbors. […] So that, we only renew the street toward us and the other two firms which agreed. We were sharing the cost, but at first time we paid it first." (SDM-6) • "Of course we have cooperation to overcome flood. We made a barrier to reduce flood. We collect the money together to uplift the road and clean up entrance gate from flood. We share all the total cost." (JDM-6)
Depending	• Counting on adaptation measures by state authorities (e.g., a dike system) • Unwillingness or inability to take own measures	• "I think the government should maintain the pump. Because actually, the pump is not working every day. That's the reason why we still have floods in this area." (SDL-3) • "Because the responsibility of this road has the government, not us. If the flood exposed to us, we only make a photograph and send it to a newspaper. The purpose is to make pressure on the government. And the decision about uplifting the road is only by the government; we don't have any power." (SDM-5)

Source: Authors

As we assured the firms of their anonymity, we use codes to refer to the interviews. The first letter indicates the case study area (J = Jakarta; S = Semarang). The second letter refers to the firm origin (D = domestic; F=foreign and J = joint venture) and the third letter provides information about the business size (L = large-scale; M = medium-sized; S = small). The classification of the business size is oriented on the definition by the OECD (2005).

5.5 Findings and discussion

5.5.1 Firms′ exposure to floods and consequences of business disruption

Although both cities are exposed to pluvial (i.e., surface water), fluvial (i.e., riverine) and tidal floods, the types, and scope of floods that affect the firms differ. The firms in Jakarta mentioned that they were primarily affected by large flood events, such as in 2002, 2007, and 2012 (e.g., JDS-8; JDM-2; JDM-5). However, small firms close to the rivers are annually affected by fluvial floods (e.g., JDS-2; JDS-5), and medium-sized firms on the coast face tidal floods several times per year (e.g., JDM-3; JDM-5). The character of floods differs in Semarang. Although

some firms have faced major flood catastrophes (e.g., in 2011 and 2014) (e.g., SDM-3; SJL-1; SDM-7), the firms are typically plagued by annual small, particularly tidal flood events (e.g., SFL-2; SDL-3; SFM-3).

The firms experienced a variety of business disruptions (cf. Table 5-4). Halting production is the most obvious disruption that hampers especially large and medium-sized firms in both cities (e.g., JDL-4; JJL-1; SDS-5; SDL-2). Further losses occurred since raw materials and intermediate or final products were damaged. More firms in Jakarta than in Semarang mentioned these losses. In both cities, especially SMEs experienced losses due to damaged raw materials or finished products.

Firms in both cities more commonly faced indirect losses due to flooding. The most common disruption was that products could not be delivered during flooding. Notably, firms in Jakarta had to deal more often with disrupted distribution channels. Firms of all business sizes faced this problem. The reason is that the disruptions occurred due to large flood events (e.g., in 2007) where large parts of the city were inundated, including the roads to the harbor, airport, or suburban industrial area. More common in Semarang than in Jakarta is that machines or vehicles are damaged by salty sea water. Half of all large firms interviewed face corroded machines or vehicles (e.g., SDS-12).

The firms interviewed typically mentioned how many days production was halted. For instance, an automotive firm (JJL-1) stated: "If you want to calculate our losses, you can count from our output. We produce 8,000 units per month. In 2007, we stopped production for two weeks." However, many indirect losses are hard to measure so that nearly all firms were unable to state their total losses precisely. Nonetheless, the firms face considerable multiple consequences:

> *"It's hard to say because if we just measure repairing the table, exchanging our computer, the products we produce in a day or how much we pay for the person, our employee. [...] It's countable but the most important for [JDL-3] is that we have brands that are known all over Indonesia. If we don't operate for a day […] [t]hen our consumers will look for our product but it doesn't exist in the market. That's the biggest advantage for us because the customer cannot find a rival product (JDL-3)."*

Although this pharmaceutical firm suffers from losses due to lower production and consequently lower sales, its recovery is fast. Their unique products prevent this firm from losing customers. However, firms, for instance in the garment sector, that compete globally have to face the consequences that their customers choose another vendor.

In contrast, the supply of raw materials or intermediate products was not so often disrupted by floods. This is true for all business sizes in both cities. Almost similarly, firms in Jakarta and

Semarang had to deal with power outages causing the production process to be (temporarily) suspended. Power outages affect especially medium-sized and large firms because they rely more on machines (e.g., JDM-3; SFL-2; SDM-5). In addition, the firms′ operations are harmed by the absence of workers. Often workers are not able to arrive at the factory due to inundated roads or because their homes are also affected by floods. Particularly, large firms in Semarang had to face this issue (e.g., SJL-1).

Table 5-4: Types of business impacts due to flooding (multiple answers possible; in percent)

Type of consequences	Jakarta	Semarang
Stop of production	57.6	52.9
Damaged raw material / products	24.2	14.7
Power outages	27.3	32.4
Machines / vehicles damaged	6.1	29.4
Disrupted distribution	60.6	23.5
Disrupted supply	15.2	14.7
Shortage of labor	9.1	17.6
Affected firms from the sample	**84.8**	**76.5**

Source: Own interviews

5.5.2 Firms′ adaptation strategies in Jakarta and Semarang

Due to the manifold business disruptions, the firms applied different adaptation measures that can be assigned to the derived six flood adaptation strategy types. Figures 5-2 and 5-3 provide an overview of the pursued flood adaptation strategies in terms of business size for each city. For simplicity, the figures only account the business type but not the origin. However, the business types are strongly aligned to the business origin. Large and medium-sized firms are either domestic or foreign, while small firms are only domestic. If there are dissimilarities between foreign and domestic firms, they will be mentioned in the statements. Overall, the figures indicate differences regarding the business size and the case study regions. Furthermore, firms not only follow one flood adaptation strategy.

With respect to Jakarta, it can be shown that large firms predominately follow a proactive strategy and less frequent a reactive, collaborative or relocating strategy. The in-depth analysis reveals that some large domestic and foreign firms have changed their adaptation strategy in Jakarta after major flood events (e.g., in 2007). Formerly, these firms pursued a reactive strategy, for instance relying on pumps, but, due to severe losses, the firms accelerated their efforts on flood adaptation and now have a proactive adaptation strategy. The firms either utilized their

financial resources more intensively to strengthen the existing infrastructure (e.g., retention ponds, strengthen flood walls) or developed new competencies, for instance, on forecasting systems. An example is an automotive firm (JJL-1):

> *"So after 2007, we made a lot of improvements because we learned from our experience from the terrible floods. […] We made some infrastructure improvements like strengthening and upgrading our walls, elevating our building and area, we added water pumps capacity and also enlarged water canal areas (JJL-1)."*

Formerly, this firm relied on pump systems, sandbags, and canals. However, the high losses in 2007 led to a fundamental rethink. In addition to the enhanced infrastructure, organizational competencies, such as an emergency response team, earlier order of raw materials and forecast information procedures were added. The firm realized that their former adaptation strategy was primarily focused on reducing the inundation level when floods take place, but preparation and forecasting were neglected. Consequently, the flood adaptation strategy shifted from a reactive to a proactive strategy. The firm relied on its financial resource and internal and external competencies. The headquarters in Japan encouraged the branch to find more effective flood risk reduction measures. Accordingly, the engineers with external consultants jointly developed the aforementioned improvement of the existing infrastructure (JJL-1; also JFL-2). Although the firms could reduce the disruption caused by floods, they stated that they still have to deal with the side effects of floods that occur through inundated roads which hamper their distribution.

Three large firms and one medium-sized enterprise that have followed a proactive strategy additionally seek a collaborative strategy to lower the flood risk more substantially. Firms collaborate with neighboring firms, residents, and local governmental authorities (e.g., JFL-2; JJL-1). This collective adaptation results in lowering the flood risk for the entire neighborhood through central pump stations and drainage canals. Although firms envisaged collective adaptation, implementation was often lacking due to the low willingness to cooperate or bureaucratic obstacles. The initiative from firm JFL-2 exemplifies this dilemma. The firm jointly discussed large-scale flood protection systems proposed by Dutch consultants with neighboring firms and residents nearby. All agreed to construct more pumps with a higher capacity and a drainage canal that would pipe the water into Jakarta′s west flood canal. The firms also offered to fund the investment and execute the construction. However, the local authorities hesitated about granting authorization for years.

The motivation of firms that pursue a relocation strategy deviates slightly from our conceptualization. The relocation strategy of SMEs (e.g., food-processing firms) is primarily determined by the governmental plan to clear the river banks from informal settlements and businesses in

order to enforce river normalization (e.g., JDS-2; JDS-7). The consideration by medium-sized and large firms to relocate production facilities originates from the fact that production permits at the current location are no longer extended (e.g., JDM-2; JDL-3). Due to the new spatial planning, industrial production close to residential and commercial areas will not be allowed anymore. Consequently, the firms envisage moving production to Jakarta′s satellite cities (e.g., Karawang or Bekasi).

Unlike large firms, medium-sized and small ones predominately favor a reactive strategy that is the most pursued strategy in Jakarta. Due to a relative stable exposure to floods, the firms attempt to respond by investing in pumps or elevating machines or their raw materials. The firms see no need to strengthen their effort on flood adaptation. Especially SMEs that face deteriorating competitiveness respond reactively to floods and tend toward more surrendering and depending strategies. They are, for instance, firms that produce plastic or metal products and have not recovered from the Asian crisis in 1997, suffer from the weak rupiah, and face increasing global competition, especially from China (JDM-2; JDS-11; JDS-12). Their weak financial basis barely enables them to invest in adequate flood adaptation measures. Simultaneously, due to disruption by floods, their competitiveness further deteriorates. Small firms, for instance, in the food-processing sector operate in a very local market with small margins. These firms are not able to invest in more productive machines (e.g., JDS-3; JDS-7). Further, many small firms pursue a ‘wait-and-see’-strategy which can be seen as maladaptation. When their plant is inundated, or distribution is impossible, they just halt their business and continue after the water has receded (e.g., JDS-10). Since this reactive attitude further deteriorates weak financial resources and primarily the firm′s viability, it appears that these firms surrender and just accept exposure to floods fatalistically. The analysis shows that seven, only small firms surrendered.

This group of firms also stresses that flood adaptation is “the responsibility of the state. I always pay taxes” (JDS-10). Although the Jakarta government has enhanced its effort toward large-scale flood adaptation measures (cf. NEISE et al., 2017), just two medium-sized firms benefit from an extended retention pond and a new pump station (JDM-3; JDM-3). Hence, many firms frequently complained about the low engagement of the local government. For instance:

> *“As long as I have been here, I have never seen the government dig the river or elevate the road. […] I can say that until now, [there have been] no activities from the government (JDS-9).”*

Consequently, the majority of the firms are not relying on state efforts even they desired that.

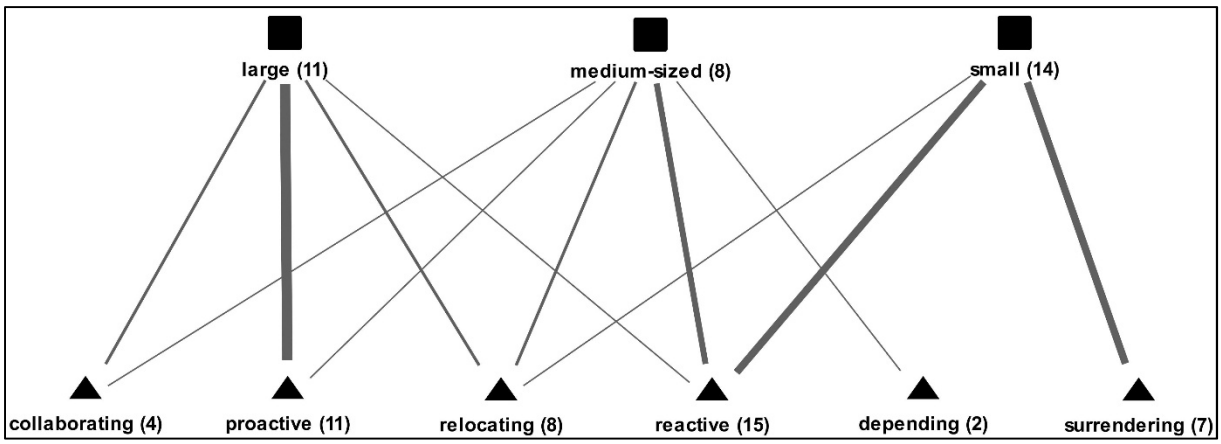

Figure 5-2: Mapping pursued flood adaptation strategy with regard to business types in Jakarta (Design: Authors)

Regarding Semarang, the analysis shows a more diverse result and less clear connections as in Jakarta. The most followed flood adaptation strategy is the reactive one that is predominately followed by large and medium-sized firms. The firms rely on their established routines. Floods are mitigated by pumps and elevating plants or streets because of the high rate of land subsidence. The manager of a food-processing firm (SDM-6) that recently elevated the plant up to 2.4 meters argued:

> *"In my humble opinion, of course, this area will face problems like floods and land subsidence. But I guess we can still survive. We can elevate our area."*

Although she is convinced that her firm can handle the exposure, her response to flooding could be interpreted as reactive. Substantial proactive adaptation is not taking place and elevating on soft soil, and the typical groundwater extraction might accelerate the speed of land subsidence. The predominance of a reactive adaptation strategy originates because seasonal floods are not seen as a severe issue. Although firms mentioned that they face difficulties with the distribution having to halt production. A typical example is a shoe producer (SDL-2). Formerly, the firm exported 90 % of their products. A long period of severe floods resulted in losing customers and lowered their financial reserves to invest in new machines:

> *"Because there were so many problems in the past. Normally, our buyers who have big brands always observe and audit our firm continuously, including an environmental audit, machinery system, and so on. And you know that our machine is too old; that's the reason why we were not selected for the audit procedure."*

At least, the firm could invest in elevating their buildings by more than 1.25 ms, purchase pumps, and build a barrier. The production facilities are no longer inundated, but the raw materials get mold, and the access street is still inundated for weeks annually. The firm had to cut the number of employees by 50 %. The firms′ efforts tend to move to a surrendering strategy since their established strategy does not substantially reduce the harm from floods:

"He [the owner] is frustrated. He doesn't want to do anything. He only thinks about how to survive in this area without sacrificing the employees" (SDL-2).

This example clearly shows that many firms in Semarang rely on their established routines and are locked into their reactive adaptation strategy which finally leads to a surrendering strategy, especially in the case of small firms. Poor dynamic capabilities, due to a lack of financial resources and low competitiveness, hamper a shift to a proactive adaptation strategy.

An exception is a food-processing firm (SFM-3) in the harbor of Semarang that follows a proactive adaptation strategy. The firm anticipated its exposure to floods. Based on the advice of a Dutch consultant, the firm implemented a flood protection system that consists of large pumps and a sea wall. Moreover, all plant buildings are constructed on deep pillars so that they are not affected by land subsidence. The firm carefully weighed the costs of their adaptation and the losses they would incur without adaptation measures. A furniture firm (SFM-2) also developed a sophisticated flood risk monitoring system. The firm uses information on tidal flood risks from the national metrological agency and monitors the land subsidence rates of their plant. The US-based headquarters receives this data, and the top management visits the plant every three months. Based on the flood risk monitoring, the headquarters will decide their future investment plans (relocation or in-situ expansion).

Similar to Jakarta, firms with a collaboration strategy could barely be found in Semarang. Some firms from all kind of business size with sufficient financial resources jointly elevated the access roads to their plants. However, these collaborations were an exception. The provision of large-scale adaptation measures with a profound solution (e.g., a water retention pond) was not envisaged. Rather, the firms seek a depending strategy. They stated that the industrial park management or state authorities are responsible for implementing adaptation measures, such as a water basin or a pump house. But, the state authorities ignored the firms′ request (e.g., SDL-2) and did not feel responsible for privately owned industrial parks. The industrial park management is perceived as unreliable and ignorant by the tenants (e.g., SJL-1). Consequently, the firms cannot rely on support from the state authorities or their lessor. Nonetheless, there are also firms that benefit from a new pump house, a new flood canal and the elevation of main streets provided by the city government. However, the firms also mention that the pump house is not always working and the street elevation requires own investment on elevating their plant. Otherwise, the water would flow into their property (e.g., SDL-2).

Overall, firms in Semarang typically consider relocating, but oftentimes it is just planned and not executed. The high rate of land subsidence, coastal erosion, and tidal flooding, as well as

the better infrastructure of the newly established industrial parks in the southern parts of Semarang, act as a trigger for relocation. Planned relocation could primarily be detected at medium-sized and large firms. For instance, a motorcycle producer (SDL-5) invested in a new factory due to expansion and better environmental conditions in the new industrial park:

> *"Previously in our former area [Genuk], we were so often exposed to flood. […] and we could not expand our land anymore. […] We saw the problem as a big burden, costly, of course wasting money and also our time; that's why we decided to move." (SDL-5; see also SDL-1)*

Relocation could also be found among small-scale firms that moved within their vicinity. In Semarang′s district with the largest concentration of manufacturing firms, Genuk, firms moved from the industrial park LIK to the industrial park Terboyo (e.g., SDS-12 SDS-13. LIK is to the south of the main road Kaligawe, and Terboyo is located to the North of this road. Although Terboyo is more affected by coastal erosion and tidal floods, through its proximity to the sea, the firms value the better-maintained roads there than in LIK:

> *"Because this industrial park [Terboyo] is the closest to our former location [LIK]. Another consideration is because our employees live around here. So if we move too far away, we are afraid that our employees will resign from their jobs. We are a company which is always thinking about the employee side" (SDS-12).*

Caring for the employees was mentioned by several firms as a reason not to relocate despite the bad conditions (e.g., SDL-2). Further considerations are proximity to customers and the supplier network (SDL-2; SDS-10), historical attachment to the current location (SDM-4; SDL-4), and financial constraints (e.g., SDS-4).

Despite the high exposure to floods, the firms (e.g., SJM-1; SDL-5; SDM-2) evaluate Semarang and its surroundings as very strategic and competitive:

> *"Of course, we have awareness [about land subsidence and floods], but this part of the industrial estate is strategic. The land is not so expensive and it is close to our port, and it is close to our suppliers in Jepara and Kudus (SJL-1)."*

Hence, these locational advantages provide benefits that apparently compensate for the losses due to floods. However, it can also indicate a contrasting picture. In flood-prone areas such as Genuk and the northern part of the city center, the firms stated that many neighboring firms went bankrupt due to the flood hazard and generally weak economic conditions (e.g., SDM-1; SDM-3; SDL-3; SDS-8).

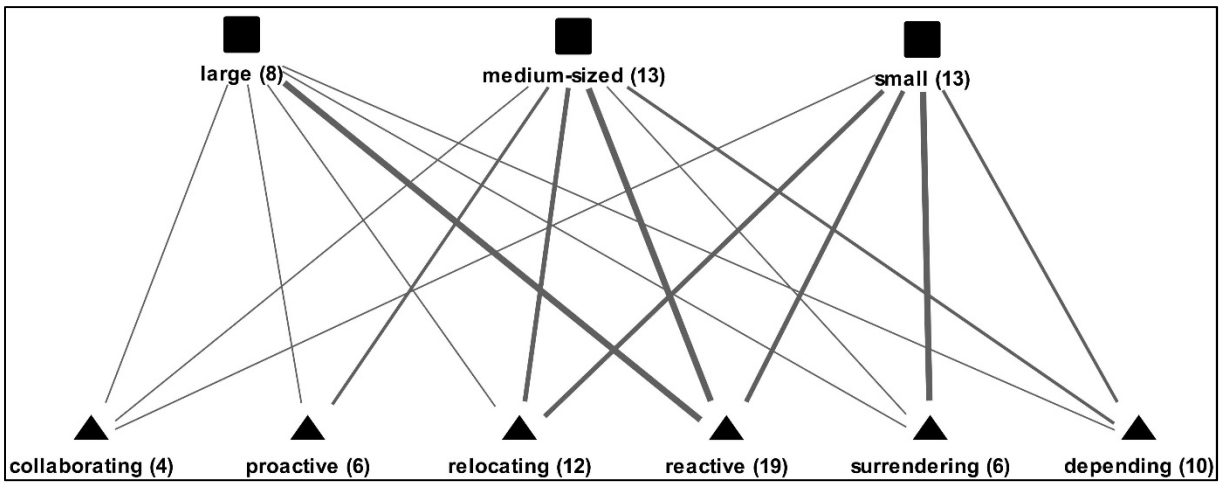

Figure 5-3: Mapping pursued flood adaptation strategy with regard to business type in Semarang (Design: Authors)

5.5.3 Discussion

In sum, our analysis shows that the choice of adaptation strategy is influenced by firms′ financial resources, the perceived threat of floods to the business and the level of competitiveness. Since large, and to a certain extent medium-sized, firms have better competitiveness (e.g., through export activities or a strong product brand) as well as organizational and technology competencies; they are also more often able to pursue proactive adaptation strategies or relocate. Hence, adaptation to floods encourages general business adaptation in order to enhance competitiveness and vice versa.

Moreover, the study indicates that flood catastrophes, for instance in 2007, caused a shift to proactive adaptation in Jakarta. This shift in the adaptation strategy was enabled through sophisticated dynamic capabilities, such as financial resources as well as organizational and technology competencies (e.g., advice from consultants, flood risk forecasting system). Our study confirms the insight of Gasbarro and Pinkse (2016) that firms with high business impact from environmental hazards developed competencies to strengthen future risk assessment and reduction. SMEs in the United Kingdom also more often became proactive to implement additional adaptation measures if a flood event hampered business operations (WEDAWATTA & INGIRIGE, 2012).

In contrast, tidal floods accelerated by coastal erosion and land subsidence provoke a permanent stressor for the firms, particularly in Semarang. But the firms underestimate the future business impact and do not utilize their competencies in order to develop new routines which can lead to a slight deterioration in their competitiveness or in the worst case to bankruptcy. Similarly to Berkhout et al. (2006), we found that in many cases firms rely on their long-established routines

that conserve reactive adaptation strategies. Berkhout et al. (2006) assumed that unclear signals of climate change make it difficult for firms to perceive the benefits of more sophisticated adaptation (e.g., a proactive adaptation strategy). This is true for, particularly, SMEs in both cities. Some of these firms also follow a surrendering strategy. Both results can be explained through low dynamic capabilities. The firms oftentimes struggle with a low financial budget that hampers investments and strong competitiveness. Therefore, tailored competencies for flood risk reduction are not developed, and what is more, they are not a priority for firms with a low level of competitiveness. Finally, particularly in Semarang, business closure or shrinking firms can be seen. This result corresponds with other studies. During the flood catastrophe 2011 in Central Thailand, particularly SMEs had difficulty in recovering due to financial constraints, lower demand, and increasing competition from larger firms (MARKS & THOMALLA, 2017). The study by Kato and Charoenrat (2018) also shows a low-level of business continuity management among SMEs in Thailand.

The impact of dynamic capabilities can especially be seen in the case of relocation. Many firms in Semarang favor relocating. However, the firms often do not pursue relocation due to financial constraints and a strong attachment to their location because of established good labor and supplier relationships (i.e., local competencies). This result confirms the theoretical considerations that firms might not relocate if they can lose their supplier networks or local cost advantages (LINNENLUECKE et al., 2011). These local competitive advantages might outweigh the disadvantages that the firms incur from flood events. In Jakarta, relocation is more encouraged by new spatial planning regulations.

In sum, the case studies disclose the interplay of routines and dynamic capabilities that determine the choice of flood adaptation strategies. However, the determining factors for each type of flood adaptation strategy differ, but it seems clear that the firms′ competitiveness plays a crucial role. Low competitiveness, accompanied by poor dynamic capabilities, deteriorates further with flood exposure. Therefore, the question of how these struggling firms can step out of this vicious circle remains open. The current situation, particularly in Semarang, indicates that the number of firms will further decrease in the flood-prone areas.

5.6 Conclusion and outlook

In many coastal areas, manufacturing firms are significantly exposed to flood events. Therefore, this paper examined how firms′ routines and dynamic capabilities drive the choice of flood adaptation strategies in Jakarta and Semarang.

Recently, a more deciphered perspective on firms′ adaptation strategies has emerged aligned with concepts from organizational and management studies. However, a research focus of manufacturing firms in developing countries has been lacking so far. Therefore, we adopted the ideas of routines and dynamic capabilities as well as existing types of flood adaptation strategies in order to derive a typology of six flood adaptation strategies. This conceptualization was applied to flood-affected manufacturing firms in Jakarta and Semarang.

The findings were based on 67 interviews with representatives from manufacturing firms. We have shown that floods are an additional stressor for manufacturing firms, apart from the normal competition they have to face. Manufacturing firms are in many ways directly (e.g., stop of production) and indirectly (e.g., disrupted distribution) affected by flood exposure. The research demonstrates that firms predominately favor a reactive strategy because they believe the investment on more pumps or elevating the plant level are sufficient measures. The second most preferred option is to relocate. This option is influenced by new spatial planning regulations in Jakarta and by a poor infrastructure quality of coastal industrials parks in Semarang. Lack of investment and locational advantages prevent many firms from relocating. A further impact has the nature of flood exposure. On the one hand, extreme flood events with high losses in Jakarta motivated especially large firms to reconsider their flood adaptation strategy. On the other hand, small periodic floods, particularly tidal inundation in Semarang challenges the firms more. The permanent and increasing return of tidal inundation causes that the firms rely on their reactive strategy, or even surrender from this harm. Moreover, collaborations between the firms and governmental support are often lacking. Consequently, firms fall back on their reactive or surrendering strategy that does not effectively reduce their flood exposure.

The study also indicates differences between the business sizes. Large and medium-sized firms that have a considerable competitive advantage or a sophisticated range of resources and competencies were able to change their flood adaptation strategies toward proactive adaptation. A different picture can be shown for SMEs with limited dynamic capabilities and a low level of competitiveness. Those firms either rely on their reactive adaptation or a surrendering strategy that does not substantially reduce their flood exposure. SMEs represent the majority of the

manufacturing sector in Jakarta and Semarang. Their ineffective flood adaptation strategies do not only jeopardize their survival but also the livelihoods of their workers and the tax revenues of the cities.

Overall, more engagement on collaboration between firms and state authorities regarding flood adaptation is strongly advised. Collective adaptation might channel investment by firms, industrial park management, and state authorities in a more efficient way. Instead of single measures by each firm that obviously not reduce the flood exposure fundamentally, co-funded large-scale flood adaptation measures, such as a dike system around industrial parks might be more promising. Generally, state authorities should put more focus on the exposure of manufacturing firms and support their adaptation initiatives in order to support an important provider of jobs and tax revenues. Especially small manufacturing firms that are the backbone of Indonesia′s economy require more governmental support, for instance, through investment funds on adaptation or a better provision of public infrastructure.

Against the background that manufacturing firms face considerable business disruption due to floods and further environmental hazards in many urban coastal areas of emerging economies, further research is recommended, for instance, in Thailand or Vietnam. A better understanding of firms′ flood adaptation strategies has political and scientific relevance. But there is still a large knowledge gap on how firms can simultaneously enhance their adaptation to increasing exposure to environmental hazards and sustain their competitive advantage. This is significant since the consequences of climate change (e.g., storm intensity, sea-level rise) as well as continuing urban, agricultural, and industrial expansion in hazard-prone areas will very likely increase firms′ necessity to adapt to environmental hazards.

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6 Are micro-, small- and medium-sized enterprises willing to contribute to collective flood risk reduction? Scenario-based field experiments from Jakarta and Semarang, Indonesia

Neise, T., Sambodo, M. T. and J. Revilla Diez (under review): Are micro-, small- and medium-sized enterprises willing to contribute to collective flood risk reduction? Scenario-based field experiments from Jakarta and Semarang, Indonesia. In: Organization & Environment

Abstract:

Micro-, small and medium-sized enterprises (MSMEs) cannot substantially reduce their exposure to floods by means of individual adaptation. State authorities also have difficulty in providing sufficient flood risk reduction. Scientific and political experts, therefore, argue that collective adaptation and firm engagement can compensate these shortcomings and simultaneously to strengthen flood protection for MSMEs. Private sector engagement in this field remains rare and, if it does occur, it is mostly dominated by large firms. Our article examines whether MSMEs are willing to contribute to flood risk reduction measures (FRRM). Based on scenario-based field experiments with 120 MSMEs, we show that 43 % of the respondents in Jakarta and Semarang are willing to contribute to FRRM. The analysis underlines the importance of social motives for explaining collective engagement by MSMEs. Overall, the article provides relevant results for policy design, suggesting stronger integration of firms into adaptation policies, thus allowing more integrative sustainable development.

Keywords: adaptation, field experiments, Indonesia, manufacturing firms, flood

6.1 Introduction

Many coastal cities in developing countries are increasingly exposed to floods. At the same time, increasing urbanization and high population growth overload capacities of state authorities. Hence, they have difficulty providing basic infrastructure (e.g., sanitation, electricity, or roads) and adequate flood risk reduction measures (FRRM), such as retention zones or forecast warning systems (BIRKMANN et al., 2016; SANDEE, 2016). The Indonesian cities, Jakarta and Semarang, are typical examples of such shortcomings. Although the city governments – in Jakarta more than in Semarang – have strengthened their focus on flood risk reduction, areas with a large share of micro-, small and medium-sized enterprises (MSMEs) in the manufacturing sector are hardly benefitting from the new investment and are still frequently hit by floods. Existing case studies show that MSMEs oftentimes rely on individual adaptation to floods, for example, installing pumps and raising the level of their plants. However, these adaptation efforts simply attempt to reduce the immediate inundation, whereas substantial solutions that could diminish the flood risk, in the long run, do not exist or are ineffective (NEISE et al., 2017).

In principle, large-scale adaptation measures with the stronger integration of MSMEs are needed to reduce the flood risks more comprehensively. For instance, a water retention area surrounded

by dikes or a maintained river system might provide more substantial flood risk reduction. However, the financial resources of a single firm are not sufficient to fund the high investment. Therefore, the provision of large-scale adaptation measures requires cooperation between all the actors affected (e.g., firms, inhabitants, and state authorities) in the neighborhood (LINNENLUECKE & GRIFFITHS, 2015).

Against this background, we argue that is worth investigating whether MSMEs are willing to join collective FRRM. So far, research has examined that MSMEs are highly impacted by floods (e.g., BAHINIPATI et al., 2017; MARKS & THOMALLA, 2017). Lately, the debate has been enlarged toward private sector engagement at the community level which can be beneficial to support political authorities with the challenging task of achieving sufficient risk reduction (e.g., IZUMI & SHAW, 2015; MCKNIGHT & LINNENLUECKE, 2016; PAUW, 2015). The Sendai Framework for Disaster Risk Reduction 2015-2030 stresses that the private sector should be an important player to achieve risk reduction (UNISDR, 2015). It is argued that firms are able to support disaster risk reduction through their financial power, know-how, and organizational resources (BIAGINI & MILLER, 2013). This seems to be a very optimistic outlook on the role of the private sector particularly with regard to MSMEs. To date, private sector engagement is still rare and is generally dominated by large multinational enterprises. Their activities frequently focus on their own interests and have often limited positive impact on risk reduction for local communities and economies (IRP, 2016; PAUW, 2015). The role of MSMEs with regard to private sector engagement is often neglected in adaptation policies.

This article contributes to the debate on how MSMEs can be an essential player in supporting the provision of large-scale FRRM. We examine whether, and under which conditions, the enterprises are willing to participate in collective adaptation (i.e., providing large-scale FRRM). This means the firms can reduce their own business disruption from floods more substantially. At the same time, their engagement supports risk reduction for residents and unburdens the state authorities from providing public adaptation measures. Our study demonstrates that the engagement of MSMEs differs from large multinational firms. Instead of their pure self-interest (e.g., reputational benefits through corporate philanthropy), MSMEs are much more driven by social motives, such as a fairly distributed investment between firms and the support by the community within a good risk governance system.

Furthermore, we address the burgeoning application of experimental methods to the research of adaptation to natural hazards that still focus predominately on households or the community but neglects the importance of firms. Thus, first, we developed a conceptual framework to determine

the contextual dimensions, under which MSMEs participate in collective adaptation. We distinguish five contextual dimensions, namely, flood experience, adaptive capacities, risk behavior, social motives, and governance. Second, we applied a novel methodological approach, called scenario-based field experiments, that combines public goods games with vignette studies applied in a field experiment setting to answer the following question: What contextual dimensions determine the willingness of MSMEs to participate in collective FRRM? Although quantitative and qualitative studies on private sector engagement are emerging, these studies primarily provide an ex post-analysis. Therefore, we complement this emerging debate with a more deciphered perspective through scenario-based field experiments. This allows the analysis ex-ante as to why proactive collective adaptation to floods is lacking.

In our scenario-based field experiment, we combined arguments of conditional cooperation and self-interest with designed vignettes (i.e., scenarios), which are usually used in experimental social and political science and nowadays increasingly by management studies (DELMAS & ARAGON-CORREA, 2016). We conducted scenario-based field experiments with decision-makers from 120 MSMEs in Jakarta and Semarang. In each treatment, the decision-makers were confronted with 15 scenarios. These scenarios contained three different forms of FRRM (polder system, river expansion, and education program) and five different actor constellations (e.g., equal payment by other firms, contribution by the community and political pressure) to examine the impact of contextual dimensions for firms' willingness to contribute to collective FRRM. In addition, we conducted a short survey, which allowed us also to include firm-specific factors, understood as additional contextual dimensions, in our multi-level regression analysis.

The article continues as follows: the second section presents the conceptual framework that provides the analytical focus of our scenario-based field experiments. It outlines the social dilemma involved in providing public goods and discusses the contextual dimensions under which firms are willing to participate in collective action. Based on this, we deductively derive hypotheses in the third section. The fourth section reviews methodological approaches in public goods games, vignette studies, and field experiments that are adopted into our scenario-based field experiments. Section 5 describes the empirical procedure of the scenario-based field experiments and the variables for our multi-level regression analysis. Section 6 presents and discusses the results of our analysis. The seventh section provides a summary of the main results, derives policy implications and discusses limitations of our research, as well as avenues for future research.

6.2 Literature review

Establishing collective adaptation

Governance approaches stress the importance of collaborative engagement in risk reduction (e.g., ADGER, 2003; DJALANTE et al., 2011). It is argued that the joint effort of all related actor groups (e.g., state authorities, non-governmental organizations, civil society, residents, and firms) might lead to more effective and legitimized disaster risk reduction (FOLKE et al., 2005; LEBEL et al., 2006). Moreover, governance approaches consider the institutional settings (e.g., power between the actors) and policy frameworks (e.g., land use planning) that enable or limit collective actions (BIRKMANN et al., 2010; DJALANTE et al., 2011). For instance, trust, self-organization, and non-opportunistic behavior have been identified as important factors for enabling collective action (LEBEL et al., 2006; OSTROM, 2000).

Furthermore, the role of firms is attracting increasing attention. Particularly, the engagement of MSMEs is seen as an integrated part of a local governance system. Accordingly, it is argued that besides their business interest in adaptation firms are simultaneously interested in reducing the harm to the community because its members are oftentimes employees or customers (MCKNIGHT & LINNENLUECKE, 2016; NEISE et al., 2018). We define the firms' engagement as collective adaptation which means that firms together with other stakeholders, such as other firms, the community, and state authorities proactively initiate strategic planned collaborative activities that result in adjusting susceptible social, ecological, or economic conditions to alleviate the harm by floods for entire neighborhoods (ADGER et al., 2005; GARSCHAGEN, 2014; NEISE et al., 2018).

However, studies on private sector engagement have, so far, focused primarily on how firms see investments in disaster risk reduction as a business opportunity (e.g., BIAGINI & MILLER, 2013; IZUMI & SHAW, 2015) or how they demonstrate a philanthropic response to natural hazards (e.g. TILCSIK & MARQUIS, 2013). In addition to this engagement, more contribution by the private sector at the community level can be beneficial to support political authorities with the challenging task of achieving sufficient risk reduction (IZUMI & SHAW, 2015; MCKNIGHT & LINNENLUECKE, 2016; PAUW, 2015). However, complete funding of the often very costly FRRM by firms is rare. This is unsurprising because these measures exhibit the characteristics of a public good. Providing such measures does not yield an immediate financial payoff, and there is a danger of free-riding behavior. Due to their non-rivalry and non-excludability character, public goods, such as large-scale adaptation measures are typically provided by the state (GEAVES & PENNING-ROWSELL, 2016). In developing countries, however, the state is often unable to provide efficient

adaptation to natural disasters (NEISE et al., 2018). As a consequence, risk reduction measures require collective action but also has to solve the social dilemma.

Solving social dilemma

Finding a solution for this social dilemma that prevents collective adaptation is of great interest for behavioral economic studies in particular in public goods games. In contrast to the standard economics assumption that actors are selfish and exhibit a free-riding behavior, behavioral economics approaches have shown that actors are willing to cooperate far more than expected. The empirical evidence is broad and reveals that cooperative behavior is the result of, for example, communication, trust, punishment of free-riders, and altruistic behavior (for an overview, see CHAUDHURI, 2011; LEDYARD, 1995). Furthermore, it has been emphasized that cooperation and thus less free-riding is determined by social norms and institutional forces (i.e., contextual dimensions) (LEDYARD, 1995). In sum, people care about other group members and are willing to sacrifice their own maximum payoff for the other members. In experiments, this behavior has been described as altruism. Accordingly, the motivation behind cooperation can be seen as the aim to maximize the joint outcome (STURM & WEIMANN, 2006; WEBER et al., 2004). However, studies show that actors expect reciprocal behavior (e.g., FEHR & GÄCHTER, 2000b). Several studies reveal that reciprocity determines whether actors will cooperate, which means that the majority of people are conditional cooperators. They prefer to cooperate only if they can expect other actors to cooperate too (FISCHBACHER et al., 2001). These findings have been well replicated in laboratory and field experiments (e.g., MARTINSSON et al., 2013).

6.3 Hypotheses

To examine what factors (e.g., reciprocity, exposure to floods) might influence the willingness of MSMEs to contribute to collective FRRM, we derive five dimensions (flood experience, adaptive capacities, risk behavior, social motives, and governance system) from research in behavioral economics, governance studies and firms′ adaptation studies (see Figure 6-1). Based on these dimensions, we develop our hypotheses for the analysis.

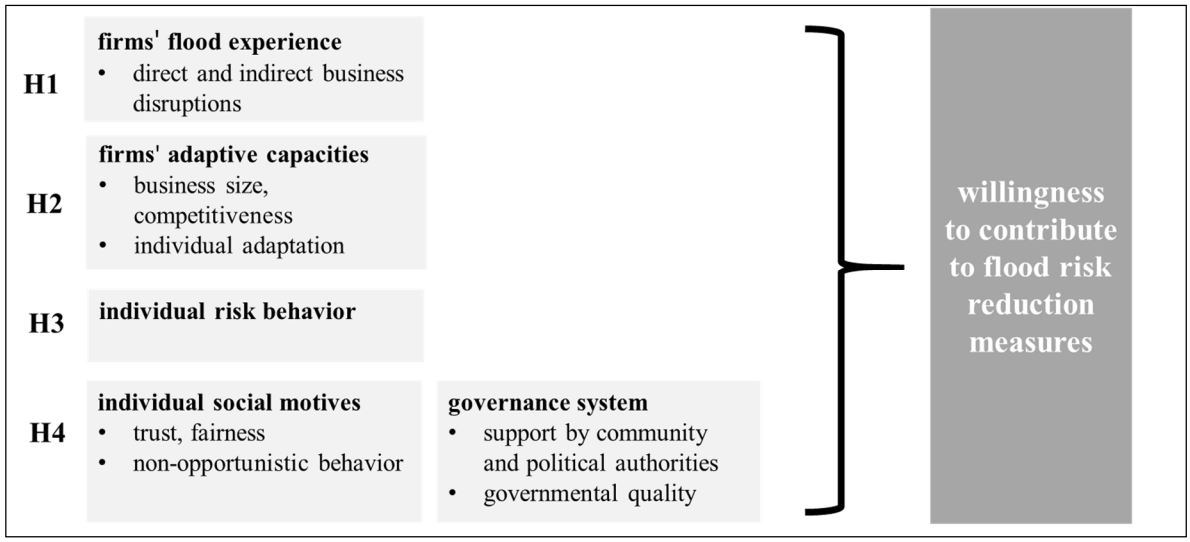


Figure 6-1: Impact of contextual dimensions on MSMEs′ contribution to FRRM (Source: Authors)

An emerging body of research shows that firms are largely affected by natural hazards because their business operations become disrupted (e.g., BUSCH, 2011; NEISE & REVILLA DIEZ, 2019; WINN et al., 2011). With regard to floods, MSMEs oftentimes belong to the most affected firms (BAHINIPATI et al., 2017; MARKS & THOMALLA, 2017). Empirical studies show that flood experience determines whether firms implement adaptation options (e.g., KREIBICH et al., 2007; 2011; WEDAWATTA & INGIRIGE, 2012). However, efforts on individual adaptation are often not sufficient to reduce the flood exposure substantially. Hence, large-scale adaptation measures are needed. However, state authorities are often unable to provide adequate flood risk reduction, and the high investment of large-scale, more effective adaptation measures cannot be financially funded alone by a single firm (NEISE et al., 2018). Forced by the circumstances, it is assumed that firms seek to collaborate on providing collective risk reduction. Their implementation will also reduce the individual flood exposure. Based on the findings that flood exposure determines individual flood adaptation, we assume that flood exposure is also an important factor that motivates MSMEs to join collective FRRM. Hence, we formulate the hypothesis:

> **Hypothesis 1:** The more MSMEs are affected by floods, the more willing they are to contribute to collective FRRM.

Moreover, MSMEs are oftentimes plagued by limited adaptive capacities, such as know-how and financial power (LINNENLUECKE & GRIFFITHS, 2015; NEISE et al., 2017). For instance, Marks and Thomalla (2017) showed that small and medium-sized enterprises (SMEs) had difficulty recovering from the flood catastrophe in 2011 in Central Thailand. On the one hand, financial constraints and lack of insurance cover hampered the rebuilding of their shops. On the other hand,

the firms suffered from lower demand, increasing competition from larger firms and poor governmental disaster relief. Consequently, many enterprises still struggle even five years after the catastrophe due to their limited adaptive capacities. Recent research by Sydnor et al. (2017) found that small businesses with less than 100 employees were more likely to close down after Hurricane Katrina. Financial constraints are also aligned with low endowments of know-how, technological capacities, and human resources that restrict MSMEs to adapt. For instance, a survey among Thai SMEs (n = 136) found that the most important reason (58.5 %) why the firms cannot prepare for disaster was lacking "knowledgeable staff," followed by lack of understanding" (26.9 %) and "lack of tools" (22.3 %) (KATO & CHAROENRAT, 2018). Therefore, sophisticated risk assessment and mitigation strategies are lacking. However, a certain amount of adaptive capacities, such as financial resources or technological capacities, is needed because firms' engagement in collective adaptation requires investing own resources (NEISE & REVILLA DIEZ 2019). Thus, we derive the following hypothesis:

> **Hypothesis 2:** The better the MSME is equipped with adaptive capacities, the more likely the MSME will contribute to collective FRRM.

A further factor that determines enterprises' ability to provide funding for joint FRRM is risk behavior. Empirical studies on households have shown that flood-affected households are more risk-averse than non-affected ones because the households perceive a greater risk of future floods (e.g., CAMERON & SHAH, 2015; SAID et al., 2015). With regard to the relationship between risk attitude and willingness to contribute to public goods, Teyssier (2012) points out that participants who are more risk-averse contribute less to a public good due to the uncertainty of the contribution of other players. Thus, we assume that flood-prone enterprises are more often risk-averse, and they are willing to contribute less to a collective FRRM. We come up with the following hypothesis:

> **Hypothesis 3**: Risk-averse firm owners and managers are more likely to contribute less to FRRM.

Experiments found that social motives, such as trust and fairness, determine the willingness to contribute to a public good (see CHAUDHURI, 2011; LEDYARD, 1995). Accordingly, we consider social motives, in terms of a contextual dimension, as having a strong impact on firms' willingness to join collective FRRM. According to findings of conditional cooperation, participants will

increase their contributions if they got information about the other contributions and the contribution is fairly distributed (CHAUDHURI & PAICHAYONTVIJIT, 2006; ENGEL & ZHURAKHOVSKA, 2014; KOCHER et al., 2015).

Based on the empirical evidence of conditional cooperation, we contradict the assumptions on private sector engagement. Literature on private sector engagement argues that firms have a pure self-interest in collective adaptation to lower their exposure to risk for their business even if others benefit from it and that firms have a prosocial attitude to reducing the exposure of the community (CSR ASIA, 2013; MCKNIGHT & LINNENLUECKE, 2016). Rather, we assume that MSMEs seek the fair distributed engagement of other firms and/or the community as well as that the government promotes and enforces laws or regulations. Both components are subsumed as a good risk governance system.

Regarding the first component (i.e., cooperation and fair distribution), we refer to the findings from literature on disaster risk governance. Respective literature stated that the joint efforts of the firms, the state authorities, and the community enable a more effective risk reduction (e.g., FOLKE et al., 2005; LEBEL et al., 2006). Therefore, it is argued that a good risk governance system makes it easier to implement collective FRRM. All the actors involved (e.g., firms, residents, state authorities) take the initiative to adapt collectively and distribute fairly the investment among all partners. This allows not only to unfold social motives, such as fairness but also limits, for instance, opportunistic behavior that might prevent the willingness to collaborate (LEBEL et al., 2006; OSTROM, 2000).

Regarding the second component, a good risk governance system includes state authorities that promote and enforce laws and regulations to stimulate the firms' engagement in FRRM besides their own actions (AGRAWALA et al., 2011). Linnenluecke and Griffiths (2015) state that the government and public agencies, as a third party, can promote the adaptation of firms if they are good role models. In Indonesia, firms are encouraged to engage in providing investment for the society or environment. Law no. 40, article 74 on limited companies and the regulation no. 93/2010 require that private firms provide funding for disaster relief and that they have social and environmental responsibility. However, the enforcement of the law and regulation is still weak (GAYO & YEON, 2013). Furthermore, Neise et al. (2017) point out that the unreliability of state authorities limits firms' engagement in collective adaptation.

According to the empirical evidence of conditional cooperation and the insights from governance studies, we formulate the hypothesis:

Hypothesis 4: A good risk governance system increases the MSME's willingness to join a collective FRRM.

6.4 Methods

Our methodological approach, the scenario-based field experiments, combines the insights on cooperative behavior from public goods games applied in behavioral economics with vignette designs that are typically applied in experimental social and political sciences (DELMAS & ARAGÓN-CORREA, 2016). The combined methodological approach is implemented in a natural setting through field experiments. In the following section, we outline the underlying rationales of each method that we considered in the conceptualization of the scenario-based field experiments.

Public goods games

To examine whether collective action takes place or fails, public good games rely on the voluntary contribution mechanism. This type of public goods game examines each player's individual contribution (ONES & PUTTERMAN, 2007). The players are asked to distribute their endowment between a public good and a private good (BARDSLEY, 2010). The aim is to examine whether players are willing to contribute to a public good or whether they prefer to free ride on the contribution of others (CHAUDHURI & PAICHAYONTVIJIT, 2006). A large number of experiments show that players' average contribution ranges between 40% and 60% (LEDYARD, 1995).

For discrete public goods, the provision point mechanism is commonly applied. Discrete public goods, such as FRRM, are only provided if a contribution threshold is reached. Accordingly, in a provision point mechanism, actors are asked to contribute to a public good that cannot be provided solely by one actor alone, thus requiring a joint contribution. If the contribution threshold, the so-called provision point, is not reached, the contribution will be refunded to the actors (MARKS & CROSON, 1998; GROOTHUIS & WHITEHEAD, 2009). According to Marks and Croson (1998), the money-back guarantee reduces the players' fear that the contribution may be given to other projects. Therefore, within the scenarios, the focus on the requested contribution to the specific FRRM is strengthened, and any biases about corruption are reduced. Related studies point out that if full information about a provision point (i.e., the costs of the public good), the money-back guarantee and the other player′s payoffs are provided, the players generally contribute the exact threshold (BAGNOLI & MCKEE, 1991).

Vignette studies

Vignette studies investigate the judgment of respondents. It is a hybrid methodological approach that combines classic experiments with the element of a survey. As a quasi-experiment, the method permits the collection of data from many respondents in a controlled setting with detailed and specific descriptions. Vignettes are carefully conceptualized descriptions of a scenario that are judged by the respondents (ATZMÜLLER & STEINER, 2010; OLL et al., 2018; WALLANDER, 2009). The scenarios should represent realistic but hypothetical situations. The systematic construction of the scenarios is based on postulated factors that might influence the judgment. Usually, practice-oriented knowledge or former research serves as the foundation for the scenarios (HOX et al., 1991; TAYLOR, 2006).

The core of the methodological approach is the experiment. A set of different vignettes is presented to the respondents to examine their intended behavior toward the scenario. An additional survey is used to collect respondent-related information as independent variables, such as risk behavior or flood experience (ATZMÜLLER & STEINER, 2010). The advantage of vignette studies is that they enable researchers to identify simultaneously the importance of the explanatory factors (i.e., scenarios) and the contextual factors (i.e., respondent characteristics) that might determine the individual decision. Besides identifying the causal relationship, this results in more realistic scenarios and a robust experimental situation (ATZMÜLLER & STEINER, 2010; TAYLOR, 2006; WALLANDER, 2009).

Field experiments

Laboratory experiments continue to dominate the empirical field of behavioral economics. They aim primarily to detect the social motives behind cooperation in a controlled setting. In contrast, studies of common pool resources rely more on field experiments, mostly conducted in developing countries to investigate collective action and power distribution among common goods (e.g., irrigation systems or fish populations) (e.g., CARPENTER & CARDENAS, 2011). Field experiments with firms are still relatively underemphasized, especially with regard to public goods games (DELMAS & ARAGON-CORREA, 2016). We decided to conduct the scenario-based field experiments with real participants, namely, MSMEs' decision-makers in their natural environment (i.e., in the place where their firm is located) instead of using students role playing decision-maker within a laboratory experiment (BARDSLEY, 2010; HARRISON & LIST, 2004).

Experiments have the advantage of allowing a deeper understanding of the contextual dimensions underlying decision-making (e.g., risk attitude, trust) that determine the willingness to participate in collective actions (EHMKE & SHOGREN, 2009). By comparing various treatments (i.e., manipulated scenarios) with different interventions, experiments make it possible to examine the effect of different micro natural, social, economic, and institutional variables (CARDENAS, 2011; DUFLO, 2006). We understand these various variables as contextual dimensions that influence (un)cooperative behavior. Laboratory experiments can deliver useful findings, but their generalization in a natural setting is questionable (CROSON et al., 2007; LEVITT & LIST, 2007). In contrast, field experiments increase the probability of obtaining more realistic results. The results can, therefore, be easily put into practice by the participants themselves, by policymakers, and non-governmental organizations (DELMAS & ARAGON-CORREA, 2016).

However, field experiments lack external validity, which is a major concern regarding their usefulness. Although field experiments reveal insights into behavioral responses to the conceptualized treatments and interventions in a distinct population of participants, the results cannot be transferred automatically to different conceptualizations and/or participant groups. This weakness is due to the local-specific context (e.g., economic and cultural factors) where the field experiments take place and where the participants belong. The field setting of the experiment can create uncontrollable, unconsidered factors that might influence the responses. Within laboratory experiments, contextual dimensions can be controlled and eliminated more easily. However, the external validity of field experiments can be improved if they are replicated with the same parameters on different local conditions and with different participant groups (BARDSLEY, 2010; DUFLO, 2006; HARRISON & LIST, 2004). The twofold approach of vignette studies (experiment and survey) makes it possible to include many control variables, such as location, competitiveness, or risk behavior to detect heterogeneities among the participants.

6.5 Empirical framework

Research design

Our scenario-based field experiments consisted of three phases: explorative phase, design phase, and implementation of the field experiments. In the explorative phase, we conducted 67 in-depth interviews with manufacturing firms (MSMEs and large enterprises) affected by flooding and interviewed 13 experts in public agencies (e.g., spatial planning and disaster management

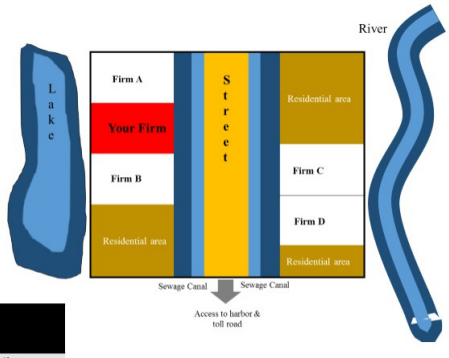
agency), non-governmental organizations (e.g., Mercy Corps) and business associations in Jakarta and Semarang between April 2015 and May 2017. The in-depth interviews centered on the impact of flood events on the manufacturing firms and implemented or envisaged adaptation measures. Overall, the interviews showed that particularly MSMEs barely participate in collective adaptation measures. The expert interviews with the political authorities dealt with the – often lacking – cooperation of political authorities with firms on flood adaptation and the respective regulations that facilitate or hamper public-private partnerships. During the interviews and additional field trips, we also gained an overview of the in situ natural settings and which FRRM the MSMEs desire. In the design phase, we developed realistic scenarios based on the interviews and impressions which were then reviewed by Indonesian experts at the Indonesian Institute of Science and behavioral economics experts. Finally, we pre-tested the scenarios in the field and adjusted the design and content slightly. In phase 3, we conducted the scenario-based field experiments between September and December 2016.

The field experiments consist of three parts. In the first part, information about the participants' risk attitude was gathered. To detect whether the owner or business director of the particular MSMEs is risk-seeking or risk-averse, we applied the following game: a hypothetical garment business only sells on the domestic market and is facing decreasing domestic demand and increasing domestic competition. The current business strategy is leading to losses, and the survival of the firm is at risk. Accordingly, the participants were given two options. Option A (i.e., risk-seeking option) includes exporting the product, which entails not only a 50% chance of increasing revenues but also a 50% chance of increased losses. In Option B (i.e., risk-averse option), the hypothetical firm continues its domestic selling strategy and thus continues to generate losses, though these will be lower than the probable losses in option A.

In the second part of our scenario-based field experiment, we ran a one-shot public goods game with the assumptions of the provision point mechanism and a money-back guarantee (‘Public goods games’ section) to detect whether firms are willing to contribute to FRRM and, if so, under what conditions. The conceptualization of a one-shot game means that the participants played each scenario once. Therefore, the participants were not able to be influenced by the decisions of other players (ENGEL & ZHURAKHOVSKA, 2014).

We conceptualized a restricted natural environment to control for possible external effects and so as not to overburden the participants. The natural environment was based on a setting that we observed during field trips as a typical flood-prone urban neighborhood (see Figure 6-2). The designed neighborhood consisted of residential buildings and five small manufacturing firms.

The small drainage canals that are typical in Indonesia and are often the cause of inundation as they are often clogged by garbage were included between the main road and the buildings. Additionally, we added a lake and river behind the buildings. The water architecture was also important for our illustration of the scenarios. Furthermore, we conceptualized five firms in each of the settings. One firm belonged to the participants; the other four firms (A, B, C, and D) represented the imaginary actors within the scenarios.



	Without river expansion	With river expansion
Annual economic losses in 5 years	60 Bil. Rupiah	10 Bil. Rupiah (less production space)
Total costs (for entire neighborhood)	0 Rupiah	75 Bil. Rupiah
Your budget	0 Rupiah	0 – 25 Bil. Rupiah

Each part of your budget you are not investing you are saving automatically for any other investment.

Figure 6-2: Example of scenario-card (river expansion) with the natural setting in the left corner (Source: Authors)

We designed 15 different scenarios on the basis of the information of our explorative phase (see Table 6-1). First, we aimed to find out which FRRM options are preferred from the MSME to join a collective adaptation. Therefore, the scenarios contained three different FRRM options: (1) a polder system, (2) an expansion of river and drainage canals, and (3) the funding of an education program on flood awareness. Second, we aimed to examine whether joint contributions by other firms or the community as well as how pressure by the governmental authorities on providing adaptation measures determine the willingness of MSMEs to participate in collective action. Therefore, five different actor constellations were designed. In the first actor constellation, the community makes a contribution. In the second one, the other four firms will contribute the same amount to reach the provision point exactly. In the third actor constellation, nobody else will contribute. In the fourth constellation, the other firms will contribute less than the necessary provision point. The last constellation includes political authorities forcing MSMEs to contribute to FRRM or fining them for not contributing. For the scenarios that include the first three actor constellations, information was provided about the amount contributed by the other players. In the case of constellations 4 and 5, no information about the other actors' contributions

was provided. The rationale behind each specific scenario is explained in more detail in the next section.

Table 6-1: Overview of scenarios

	1) Community contribution	2) Fair contribution	3) Self-interest	4) Non-fair contribution	5) Political Pressure
A) Polder System	A1	A2	A3	A4	A5
B) River expansion	B1	B2	B3	B4	B5
C) Education program	C1	C2	C3	C4	C5

Own illustration based on field experiments

In a total of 120 manufacturing MSMEs, 60 each in Jakarta and Semarang, participated in the scenario-based field experiments. Because each decision-maker of an MSME had to play each of the 15 scenarios, 1,800 observations (120 firms × 15 scenarios) were gathered. The participants were selected randomly if they had no more than 250 employees and their business had been disrupted by floods within the last 5 years.

The participants were mainly the business owner or at least the business operating manager. Our prior in-depth interviews with MSMEs found that strategic decision-making is mainly top down and is predominately taken by the business owner or the director. Furthermore, we conducted the experiments mostly with male participants who were very experienced in running a business. Moreover, the participants were instructed to make their decisions in respect of their own experience in the firm. Thus, it can be assumed that their individual judgments represent to a large extent the MSME's willingness to cooperate or not. The participants' enterprises have, on average, 37.4 employees and 18 years of business experience. The majority of the firms belong to metal production, food processing, or furniture industry. The firms experience at least one flood event that disrupted their business per year.

The experiments were conducted jointly by Indonesian and German researchers. The procedure of the field experiments and the information given to the participants strictly adhered to prior established and standardized guidelines. Only the order of the scenarios was constantly changed randomly so as to prevent order bias. To ensure that the participants understood the experiment, the procedure was explained carefully. Once the participant was able to play the test game successfully, the real experiment started. Additionally, illustrations of the FRRM option and a table containing the budget, costs, the amount by which the inundation level could be reduced, and economic losses with and without the option were drawn on ‘scenario-cards’ (see Figure 6-2). It was always mentioned that the remaining budget that the participants do not contribute to FRRM could be used for other business-related investments. In contrast to many other field experiments,

we decided that the participants should not receive a monetary payoff. The pre-tests showed that a monetary payoff confused the participants. Furthermore, particularly in medium-sized firms, the payoff was refused because the actors were afraid to violate their firm's anti-corruption policy.

After the experiment, a survey was conducted as the third part of the scenario-based field experiment. The survey contained questions about the firms' characteristics (e.g., number of employees), their flood exposure, individual adaptation efforts, and evaluation of the institutional environment (see Table 2). The information was used to develop the independent variables for our multi-level regression analysis (‘Research design’ section).

Multi-level regression analysis

To analyze the obtained 1,800 observations within our scenario-based field experiments and to identify the contextual dimensions that influence MSMEs' willingness to contribute to collective action, we applied a multi-level regression analysis. Because each MSME has played all 15 scenarios (i.e., vignettes), the data are characterized by a hierarchical structure. The vignettes are clustered within the higher participants' levels: the firms and sub-district characteristics (ROOKS et al., 2016; WALLANDER, 2009). Multi-level models allow considering the differences and interdependences between characteristics of the scenarios, the firms, and the sub-district level (PARK et al., 2012). Hence, we process our data taking the hierarchical structure into account and by running a multi-level binary-logistic regression. Many researchers using vignette studies emphasize that multi-level models provide a more accurate analysis of the hierarchical structure than standard ordinary least-squares regressions (e.g., HOX et al., 1991; OLL et al., 2018). Running an ordinary least-squares regression with a clustered data set would result in standard errors being underestimated because the residuals are not independent (RAUDENBUSH & BRYK, 1992; ROOKS et al., 2016).

The dependent variable of our analysis is ‘willingness to contribute to FRRM’. In line with the provision point mechanism, just the given amount that reaches the threshold was considered. Accordingly, our dependent variable is a dummy, where 1 means that the threshold was reached, and the MSMEs expressed the willingness to contribute to FRRM under the circumstances of each scenario.

Several explanatory variables are derived from the scenarios to detect whether the manipulation of the actor constellations and the different FRRM (i.e., contextual dimensions) determine the

willingness to contribute. Table 6-2 provides an overview of all the variables included in our model. In the following section, we explain which explanatory and control variables we used for each hypothesis.

With regard to hypothesis 1 (i.e., flood experience), we developed two explanatory variables. First, the dummy variable "high direct flood exposure" contains that the firm was affected by floods more than once per year within the last 5 years. Second, the number of flood events between 2011 and 2013 in each of the sub-districts was calculated based on the Village Potential Survey (BPS, 2015). This information (variable 'indirect flood exposure') serves as a proxy to indicate the indirect flood exposure that hampers the business operation. Two control variables are included in our data set. To control whether the effectiveness of the FRRM influences the willingness to contribute, we developed the variable 'reduction inundation level'. The variable includes the information given in the scenarios about how much each FRRM option reduces the inundation level. We also controlled for the effect of the type of FRRM. The variable 'technological option' includes all scenarios with the FRRM options polder system or river expansion. This control variable has two backgrounds. An experiment by Pillutla and Chen (1999) shows that people act less cooperatively if the contribution is made to an economic public good (here, a joint investment fund) rather than to a non-economic public good (here, a social event). Accordingly, it can be expected that the respondents will be less likely to choose the polder system and river expansion. In contrast, investment in FRRM is traditionally oriented toward technological measures, such as pump or dike systems in developing countries (ABBAS et al., 2015; AMENDOLA et al., 2008). It is expected that the MSMEs will request more technological options and see them as more effective than soft adaptation measures that are often already undertaken by firms jointly with the community (NEISE et al., 2017).

Hypothesis 2 (i.e., adaptive capacities) was tested by two explanatory variables. First, the number of employees (variable 'business size') serves as a proxy for the firms' endowment of adaptive capacities. Second, we used the information about the turnover development of the MSME as a proxy to detect whether the firm is well positioned competitively. It is assumed that the larger the business and the more competitive, the more adaptive capacities (e.g., financial resources, technological capacities) are possessed by the MSME. Therefore, the enterprises can expand their scope for action to adapt more proactively and take a higher investment risk.

Hypothesis 3 (i.e., risk behavior) was tested by the dummy variable 'risk-averse behavior'. The variable was derived from the risk game conducted (see 'Research design' section). The obtained results serve as a proxy to test whether the participant's risk attitude determines the willingness

to take the risk to invest in a large-scale FRRM. Thus, option B (i.e., risk-averse option) is interpreted that the participant is averse to take the investment risk.

To verify hypothesis 4 (i.e., good risk governance), we designed five variables. Regarding the first component of good risk governance (i.e., cooperation and fair distribution), the variable 'fairness' indicates that the contribution needed is fairly distributed among all firms, and the variable 'community support' demonstrates whether the residents contribute to fund the FRRM. The variable 'self-interest' serves as a control variable to test whether the MSMEs are willing to fund the FRRM without any support by other firms or the community. The control variables 'CSR' and 'cooperation' are used as proxies to characterize the MSME as typically cooperative ('cooperation') and/or as a firm that demonstrates corporate philanthropic activities ('CSR') to control whether cooperative and/or philanthropic behavior influence voluntary contribution The integration of both variables addresses the literature on private sector engagement (see MCKNIGHT & LINNENLUECKE, 2016; TILCSIK & MARQUIS, 2013).

Regarding the second component (i.e., the role of political authorities), we included three variables in our analysis. The variable 'political pressure' tests how the request from political authorities influences the willingness to contribute. Moreover, we included an assessment of the governmental quality derived from the survey. First, we asked how MSMEs evaluated the support provided by the government during flood events (variable 'support during floods'). Second, we asked MSMEs to assess how easy it is to obtain permissions for construction or export licenses, as a proxy for regulatory quality. Both variables express whether the state authorities are a good role model by supporting flood risk reduction or promoting laws and regulations that might stimulate engagement by MSMEs (LINNENLUECKE & GRIFFITHS, 2015).

The general control variables 'individual adaptation' and 'planned relocation' aim to indicate that the MSME is not willing to contribute because they already implement individual options ('individual adaptation'), such as own pump systems, or envisage leaving the flood-prone location in the near future ('planned relocation'). The control dummy variable 'Jakarta' was included in the analysis to compare the MSMEs' willingness to contribute between Jakarta and Semarang.

Table 6-2: Overview of independent variables

	Variables	Description	Range	
			Min	Max
Scenario characteristics [a)]	Technological option (1 = yes)	Scenarios with technological measures: polder system or river expansion (scenarios A, B)	0	1
	Reduction inundation level	Percentage of reduced inundation level (scenarios A = 100%; B = 83 % and C = 75 %	75	100
	Fairness (1 = yes)	Amount of contribution needed is equally distributed between all five firms (scenarios A2, B2, C2)	0	1
	Self-interest (1 = yes)	Participants were requested to fund FRRM alone (scenarios A3, B3, C3)	0	1
	Community support (1 = yes)	Residents also contribute to the FRRM (scenarios A1, B1, C1)	0	1
	Political pressure (1 = yes)	State authorities demand implementation of flood protection funded by firms (scenarios A5, B5, C5)	0	1
Firm characteristics [b)]	Risk-averse behavior (1 = yes)	Participants do not change their business model and export products during tough market conditions	0	1
	High direct flood exposure (1 = yes)	The firm was affected by floods more than once per year within the last 5 years	0	4
	Business size	Number of employees	1	250
	Good competitiveness (1 = yes)	The firm stated that turnover increased in the last 5 years	0	1
	Individual adaptation (1 = yes)	Firm implemented own flood protection measures	0	1
	Planned relocation (1 = yes)	Firm is planning to relocate business	0	1
	CSR (1 = yes)	Firm supports the local community with ecological or social programs	0	1
	Cooperation (1 = yes)	Firm cooperates with other firms (e.g., sale, product development)	0	1
	Support during floods (6 = very good – 1 = very poor)	Rating of the support of state authorities during flood incidents	1	6
	Regulatory quality (6 = very good – 1 = very poor)	Rating of the support of state authorities on obtaining permission (e.g., export licenses)	1	6
Sub-district characteristics	Indirect flood exposure[c)]	Number of flood events in sub-district 2011-2013 where the firm is located	0	24
	Jakarta (1 = yes)[b)]	Firm is located in Jakarta	0	1

a) derived from scenarios; b) derived from survey; c) derived from Village Potential Survey 2014 (BPS, 2015) Source: Authors

6.6 Results and discussion

Discussion of descriptive results

The analysis shows that 43.3 % of all respondents are willing to contribute to the presented FRRM, irrespective of the actor constellations (see Figure 6-3). This is already a clear indication that firms are willing to participate in collective action. The polder system (scenarios A) and the education program (scenarios C) are favored over river expansion (scenarios B). However, the difference between the three options is not very large.

An analysis of each scenario shows a more differentiated picture. In the scenarios where either the community or the other firms will contribute, the willingness to engage in FRRM increases above the average level. The scenarios (A5, B5, and C5), in which state authorities put pressure on the MSMEs, deliver a below average willingness. In the scenarios where no other actor contributes (i.e., self-interest) or the contribution by the other firms is below the provision point threshold (i.e., non-fair contribution), the share of contributing participants falls below the overall average. Especially in the self-interest scenarios, the willingness to engage in collective action is very low. Therefore, it can be indicated, first, that actor constellations have an impact on the participants' willingness to contribute and second, that scenarios with a fair contribution by other actors (firms or community) lead to a higher share of contributing firms (hypothesis 4).

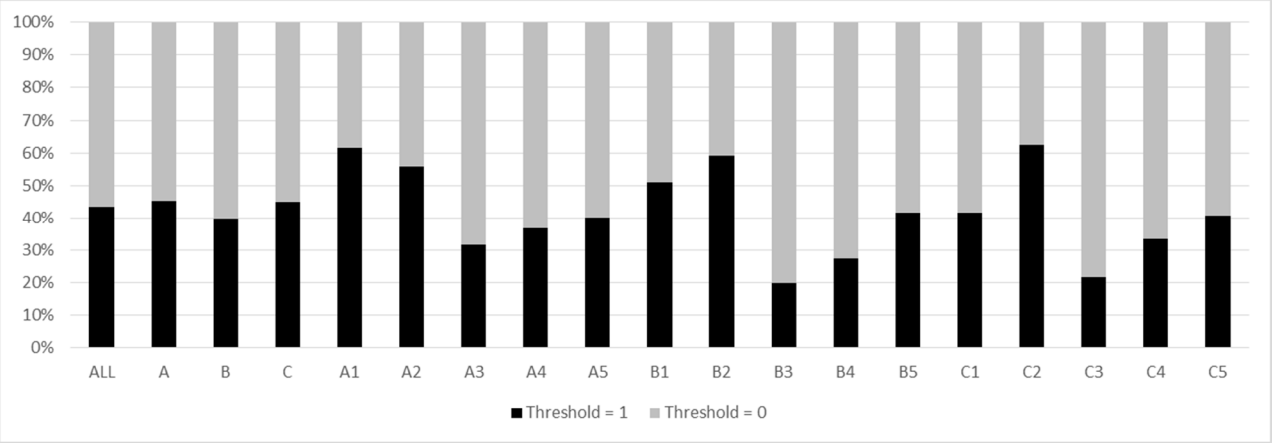


Figure 6-3: Comparison of contribution to FRRM in different scenarios (red line = average share of contribution in all scenarios) (Source: Authors)

With respect to the firm-level characteristics, the expected results were obtained (see Table 6-3): more competitive and successful firms demonstrate a higher willingness to contribute voluntarily than less competitive firms (48.5% vs. 42%). These results seem to prove hypothesis 2. Likewise, 'risk-averse' MSMEs are willing to contribute less than risk-seeking MSMEs (32.4% vs. 47.8%).

This seems to verify hypothesis 3. Interestingly, MSMEs in Jakarta (36.9%) show a considerably less positive attitude toward collaborative action than those in Semarang (49.8%).

Table 6-3: Impact of independent variables on willingness to contribute (share as %)

	If independent variable = yes			If independent variable = no		
Independent variables	Contri-buting	Not con-tributing	Obser-vations	Contri-buting	Not contri-buting	Observa-tions
Scenario characteristics						
Technological option	42.5	57.5	1,200	45.0	55.0	600
Fairness	59.2	40.8	360	39.4	60.6	1,440
Self-interest	24.4	75.6	360	48.1	51.9	1,440
Community support	59.7	40.3	360	39.2	60.8	1,440
Political pressure	40.8	59.2	360	44.0	56.0	1,440
Firm characteristics						
Risk-averse behavior	32,4	67,6	525	47,8	52,2	1,275
High direct flood exposure	42.8	57.2	600	43.6	56.4	1,200
Good competitiveness	48.5	51.5	375	42.0	58.0	1,425
Individual adaptation	42.5	57.5	1,455	47.0	53.0	345
Planned relocation	35.9	64.1	435	45.7	54.3	1,365
CSR	42.0	58.0	1,425	48.5	51.5	375
Cooperation	43.4	56.6	1,590	42.9	57.1	210
Sub-district characteristics						
Jakarta	36.9	63.1	900	49.8	50.2	900

Own calculation based on experiments

For the numeric independent variables, the mean was calculated for the case that the participant is willing to contribute and for the case that he/she is not (see Table 6-4). Contributing MSMEs are exposed to floods on average one time more than non-contributing MSMEs. This gives a direction to confirm hypothesis 1. MSMEs that contribute to FRRM have fewer employees on average (31.3) than those that do not contribute (42 employees). The result directs to falsify hypothesis 2.

Table 6-4: Mean and standard deviation of independent variables

	If, willingness to contribute = yes (n = 780)		= no (n = 1,020)	
Variables	Mean	Std. Dev.	Mean	Std. Dev.
Scenario characteristics				
Reduction inundation level	86.1	10.6	85.9	10.3
Firm characteristics				
Business size	31.3	55.8	42.0	65.8
Support during floods	4.2	1.4	4.1	1.5
Regulatory quality	4.8	1.0	4.8	1.2
Sub-district characteristics				
Indirect flood exposure	6.1	5.4	5.1	3.9

Own calculation based on experiments

These descriptive results provide a first insight into contextual dimensions influencing the willingness of MSMEs to participate in FRRM and give first directions to test our hypotheses. To examine the importance of independent variables for determining the likelihood of participating in collective action, a multi-level binary-logistic regression is applied in the next section.

Discussion of analytical results

First, we estimate the intercept null model to test whether a multi-level analysis is appropriate. The intercept null model contains no independent variable but decomposes the variance separately into the three independent parts (scenario, firm, and sub-district characteristics) (HOX, 2010). After that, the intra-cluster correlation is examined. The results show that, in total, 50% of the variance in the likelihood of contributing to FRRM can be explained by the firm-level and sub-district level characteristics. Hence, the scenario characteristics explain 50% whether firms are willing to collaborate. However, the firm-level characteristics have a much stronger effect on the likelihood of participating in FRRM (46.7%) than those at sub-district level (3.2%). This result is not surprising because many studies have shown that particularly individual characteristics determine cooperative behavior (for an overview, see LEDYARD et al., 1995). Furthermore, firm-level characteristics are even more important than local flood exposure or the city where the MSME is located to explain the willingness to participate in FRRM.

Taking a closer look at the fixed effects allows the interpretation of the estimated impact of our independent variables on contributing to collective FRRM. We focus here on model 3 to discuss the results when all independent variables are included. Table 6-5 below displays the total results of the analysis.

Regarding hypothesis 1, it can be stated that the number of flood events in the sub-district increases the likelihood of firms being willing to contribute to FRRM. However, the impact of local indirect flood exposure is only slightly significantly positive. Accordingly, this shows that general flood proneness matters but does not play a large role as the firm level determinants. Surprisingly, direct flood exposure (i.e., variable ‘high flood experience’) provides no significant result. The result does not indicate any impact of direct firms' flood exposure to the willingness to cooperate. Hence, hypothesis 1 can just be confirmed with respect to the indirect flood proneness of the MSME's location but not with regard to individual flood exposure. It seems that the enterprises are interested to cooperate voluntarily if their neighborhood is inundated because the enterprises will suffer, for instance, from power outages or halted production due to disrupted

supply chains or the absence of the employees because the streets or their home are affected by flooding (NEISE & REVILLA DIEZ, 2019).

When it comes to the question what kind of collective adaptation measures are preferred, the control variable 'technological option' indicates that the participants more likely fund educational programs than technical solutions, like polder system and river expansion. This result confirms the findings of Pillutla and Chen (1999) who showed that people cooperate if the public good has a social purpose. The result also shows that the MSMEs do not feel responsible to provide flood risk infrastructure, but they are encouraged to fund soft adaptation measures.

With respect to the expected positive impact of sufficient adaptive capacities, the result shows that the increasing turnover of an MSME increases its willingness to contribute. The MSMEs clearly recognize their own benefits in participating in collective FRRM, which increases the likelihood of their willingness to contribute. In this respect, hypothesis 2 can be confirmed. However, the variable 'business size' contradicts the hypothesis. The analysis shows that the smaller the business, the more likely the MSME is willing to participate in collective action. The result is slightly significant. Because of limited resources, smaller firms see the advantages of pooling assets for effective collective FRRM.

Our result on risk behavior confirms hypothesis 3. If the firms' decision-makers are risk-averse, then they are less willing to invest in collective FRRM. Risk-averse behavior has the most impact that decreases the willingness to cooperate. The result also confirms the results obtained by Teyssier (2012), according to which, risk-averse participants are willing to contribute less to the provision of a public good. The result suggests that the investment risk of the FRRM should be alleviated, for instance, through an insurance scheme to increase the participation of risk-averse owners or managers. Furthermore, the risk might be shared among actors affected within a governance system as hypothesis 4 is investigating.

Regarding hypothesis 4, it can be shown that the respondents are more likely to contribute to the provision of FRRM, either if the contribution is distributed fairly among the firms or if the community also contributes. These two variables are the most significant indicators that influence the likelihood of participating in collective adaptation measures. The control variable 'self-interest' decreases the likelihood of participation significantly. The firms do not strive to fund alone a collective FRRM. This result is not surprising and confirms the findings of other studies revealing that players acknowledge reciprocity, that is, conditional cooperation (e.g., FEHR & GÄCHTER, 2000b; FISCHBACHER et al., 2001). Moreover, these results underpin the fact that the

participants seek to collaborate within a good risk governance system where all the affected actors contribute to the provision of the FRRM.

Regarding the literature on private sector engagement, the result clearly demonstrates that MSMEs are more driven by social motives than their self-interest to strengthen their reputation or purely their competitiveness. This finding contradicts the literature on large and multinational firms that rather see disaster risk reduction as a business opportunity or as a philanthropic purpose (e.g., BIAGINI & MILLER, 2013; IZUMI & SHAW, 2015; TILCSIK & MARQUIS, 2013).

However, we did not find evidence that enterprises' general cooperation behavior and/or their engagement in corporate social responsibility influence their willingness to fund a collective FRRM. In contrast to large-scale firms, it might also be unlikely that MSMEs are motivated by a philanthropic behavior addressed as an important motivational factor for large-scale firms in the literature (see MCKNIGHT & LINNENLUECKE, 2016; TILCSIK & MARQUIS, 2013). The control variable 'cooperation' provides no significant relationship. It seems that pure business relationships with other firms do not play any role. However, the variable 'fairness' demonstrates that MSMEs aim to alleviate the flood risk with their neighboring firms, even if they might be their competitor. Combined with the positive impact of the variable 'community support', it can be stated that the enterprises are interested to share the costs between all affected firms and residents and improve the local conditions. Our in-depth interviews revealed that the enterprises are highly attached to their place and interested in having a good relationship with their neighbors because the residents are often their employees and the firms help each other in difficult times, for instance, during flood events (see NEISE & REVILLA DIEZ, 2019).

Because a good risk governance system also includes the responsibility of the government, analysis shows that hypothesis 3 can be partly confirmed. If governmental support during flood events is assessed positively by the MSMEs, then they, in turn, also show more willingness to contribute to collective FRRM. In contrast, the more positively the regulatory quality is assessed, the less likely it is that the MSMEs will contribute. The different results can be interpreted as follows: on the one hand, the firms appreciate active governmental flood relief. Consequently, they are also more motivated to contribute to proactive FRRM and to support the flood mitigation policy. On the other hand, firms are more likely to take the initiative themselves if the state authorities promote private sector development by well-formulated regulations. The result is in line with the ideas of private sector engagement that sound regulatory frameworks can stimulate firms

to invest in disaster risk reduction (AGRAWALA et al., 2011). However, our prior in-depth interviews showed that the firms' engagement is also hampered by very bureaucratic and time-consuming procedures.

With regard to political pressure, the results indicate a significant positive impact on the likelihood of contribution. It can be stated that a good risk governance system that includes law enforcement by political authorities has a positive impact on the firms' willingness to participate in collective adaptation. This result underpins that the firms comply with the laws and regulations. Hypothesis 4 can, therefore, be verified. However, our prior interviews revealed that firms are unsatisfied with this policy because they miss similar engagement by the state authorities. As a consequence, in particular, large firms comply with this policy but reduce further engagement on other corporate social responsibility activities (see NEISE et al., 2017). As a result, the firms do not engage in polder systems that might reduce the in-situ flood risk and from whom the society and also the firms could benefit. Hence, it is suggested that the impact of regulations and laws on voluntary contribution should be further examined.

Interestingly, our multi-level analysis also demonstrates that MSMEs in Jakarta are less likely to contribute than firms in Semarang. This result can be explained in two ways. First, firms in Semarang demonstrate a more collaborative commitment than those in Jakarta. This confirms findings according to which collective action can be undertaken more easily in relatively smaller communities (e.g., CURRY, 2015). Second, firms in Jakarta do not see a high necessity to fund their own FRRM. More considerable, state-led, and internationally funded FRRM has been taking place in Jakarta recently (WORLD BANK, 2014), whereas the study sites in Semarang have been disregarded largely by such initiatives. In addition, the analysis demonstrates that individual adaptation shows a clear significant likelihood that the firms are not willing to cooperate because they perceive their own activities, such as sandbags or a pump system, as sufficient. However, our field study has shown that these adaptation measures have a substantial effect that barely alleviates flood risk (see NEISE & REVILLA DIEZ, 2019). Regarding the impact of plans to relocate the business activities, the analysis does not reveal any significant relationship.

In sum, the multi-level analysis yields interesting results and shows clearly that the scenario and firm-specific explanatory variables explain whether MSMEs are willing to contribute to FRRM. Especially the firms' adaptive capacities are important contextual dimensions that show whether the participants are willing to contribute or not. Competitive firms are more likely to increase voluntary contributions, whereas risk-averse behavior decreases the likelihood to cooperate. With regard to social motives, it can be stated that voluntary contribution to FRRM is more likely

if the contribution is fair and supported by the community (FEHR & GÄCHTER, 2000b; MCKNIGHT & LINNENLUECKE, 2016). This also stresses that the willingness to provide a collective FRRM requires a good risk governance system that includes the engagement of state authorities and apparently a certain pressure on the firms by the state authorities. However, our prior in-depth interviews highlighted that political pressure also frustrated the firms especially if the firms are dissatisfied with governmental support. Moreover, it decreases voluntary engagement by the firms (see NEISE et al., 2017). Hence, legal obligations should be carefully designed so that they do not discourage the firms' voluntary engagement on disaster risk reduction and other social, ecological, or economic activities. Moreover, the different results between Jakarta and Semarang demonstrate that local characteristics play a crucial role.

Table 6-5: Multi-level binary-logistic regression results for voluntary contribution to FRRM

	Odds ratio (standard error)	Odds ratio (standard error)	Odds ratio (standard error)	Odds ratio (standard error)
Fixed effects	model 0	model 1	model 2	model 3
Scenario characteristics				
Technological option		0.571***	0.571***	0.571***
		(0.117)	(0.117)	(0.117)
Reduction inundation level		1.023**	1.023**	1.023**
		(0.009)	(0.009)	(0.009)
Fairness		6.192***	6.185***	6.190***
		(1.285)	(1.283)	(1.284)
Self-interest		0.541***	0.541***	0.540***
		(0.112)	(0.112)	(0.112)
Community support		6.446***	6.439***	6.443***
		(1.342)	(1.340)	(1.341)
Political pressure		1.775***	1.775***	1.776***
		(0.349)	(0.350)	(0.350)
Firm characteristics				
Risk-averse behavior			0.237***	0.298**
			(0.109)	(0.133)
High direct flood exposure			0.978	1.153
			(0.413)	(0.471)
Business size			0.992**	0.992**
			(0.003)	(0.003)
Good competitiveness			3.102**	2.966**
			(1.674)	(1.540)
Individual adaptation			0.352**	0.310**
			(0.189)	(0.163)
Planned relocation			0.524	0.590
			(0.245)	(0.268)
CSR			0.765	0.633
			(0.385)	(0.308)
Cooperation			0.505*	0.582

			(0.209)	(0.234)
Support during floods			1.192	1.273*
			(0.175)	(0.183)
Regulatory quality			0.722	0.704*
			(0.145)	(0.137)
Sub-district characteristics				
Indirect flood exposure				1.076*
				(0.044)
Jakarta				0.310***
				(0.124)
Constant	-0.493**	0.055***	0.243	0.316
	(0.209)	(0.041)	(0.350)	(0.450)
Random effects				
Sub-district (_cons)	0.212	0.299	8.66e-13	2.00e-33
Sub-district > firm (_cons)	3.072	4.440	3.831	3.465
Model fit statistics				
Observations	1,800	1,800	1,800	1,800
ICC sub-district	0.032	0.037	1.217e-13	2.966e-34
ICC firm	0.467	0.553	0.538	0.513
Prob > chi2	0.000	0.000	0.000	0.000
Deviance	2026.457	1786.223	1763.775	1753.423

***Significant at 1% level (p<0.01); **Significant at 5% level (p<0.05); *Significant at 10% level (p<0.1); ICC= intra-cluster correlation

Source: Own calculation

6.7 Conclusion

Summary

Surprisingly, studies on the willingness of the private sector to participate in collective adaptation measures are scarce, particularly regarding the role of MSMEs. This article, therefore, investigated the conditions under which MSMEs are willing to contribute voluntarily to FRRM. Because of considerable flood exposure and the absence of adequate flood risk reduction, Jakarta and Semarang represent good examples for many flood-prone areas in Southeast Asia were MSMEs are often left alone to protect their businesses and their local environment.

Overall, this article provides three contributions to the literature. First, because MSMEs are generally neglected in the discourses on private sector engagement, this study developed a conceptual framework that aimed to bring MSMEs – the most common form of firms in developing countries – into this debate and to outline how collective adaptation toward FRRM can arise. It was pointed out that collective adaptation is not easily achievable due to a social dilemma: public goods are not satisfactorily produced by the state, and firms have no incentive to fund a public

good because non-contributors can free ride. This is particularly relevant for FRRM because they are typically regarded as public goods. Public goods games examine how collective action can be achieved. Social motives, such as fairness or prosocial behavior, play an important role in solving this social dilemma.

Second, this article provided a novel approach in methodological terms, called scenario-based field experiments. The basic assumptions of public goods games were combined with the scenario design by vignette studies. This combination made it possible to examine whether firms are willing to contribute to collective adaptation. Based on three different FRRM options (polder system, river expansion, and education program) and five different actor constellations, a total of 15 scenarios were judged by 120 participants of MSMEs, leading to 1,800 observations.

The analysis showed that 43% of all participants would voluntarily contribute to the provision of FRRM. This result corresponds to the large number of experiments where the players' average contribution ranges between 40% and 60%. Running a multi-level analysis revealed that, primarily, social motives and firms' adaptive capacities have important explanatory power with regard to explaining the MSMEs' willingness to contribute. This study demonstrates that, in contrast to the results from large firms, MSMEs are less encouraged through their pure self-interest (e.g., reputational benefits through corporate philanthropy) to contribute to the provision of a public good (i.e., large-scale FRRM). Rather, the enterprises are interested in participating in a joint, fairly distributed collective adaptation that will also substantially reduce their own flood risk (i.e., a good risk governance system). Our results with regard to the importance of social motives correspond with former field and laboratory studies and complement the literature on private sector engagement that primarily focusses on large and multinational firms.

Third, we also show that risk behavior, flood experience, and firms' adaptive capacities strongly influence collective adaptation. Firms are also more likely to be willing to contribute if government support during flood incidents is evaluated positively. Therefore, the voluntary contribution of firms should be seen more as additional support to leverage flood risk reduction but not as a substitute for the duty of the state. Reliable state authorities with sufficient public funding are still crucial to guide, supervise, and maintain FRRM. Interestingly, the analysis also reveals a locational difference in the willingness to contribute to FRRM. MSMEs in Semarang are more willing to contribute than those in Jakarta.

In sum, our analysis provided a more deciphered perspective on how MSMEs might be willing to contribute to collective FRRM. Particularly, we underpin that contextual dimensions (e.g.,

social motives, firms' adaptive capacities) explain whether MSMEs contribute voluntarily or not. In particular, we attempted to demonstrate the usefulness of linking research on collective adaptation with the methodological considerations of behavioral economics. We pointed out that public goods games through scenario-based field experiments can provide meaningful insights on how MSMEs can be better integrated into collective adaptation. Such engagement is not only missing in the flood-prone cities of Jakarta and Semarang but also in many places in developing countries (e.g., Bangkok, Ho Chi Minh City).

Policy recommendations

Because this article addresses the current debate on how firms can support disaster risk reduction which has attracted considerable attention in political discourse, we derive some policy implications based on our analysis.

First, engagement by firms, particularly MSMEs, can be a powerful tool to support state agencies with FRRM. Our analysis underpins the idea that private sector engagement in FRRM should not focus predominantly on large-scale multinational enterprises. Although their engagement is valuable and should be enhanced, further locally embedded MSMEs should also be integrated into political programs, encouraging more engagement in collective adaptation directed at the needs of the vast majority of firms in developing countries, namely, MSMEs. In this respect, governance systems can be a powerful tool to implement and legitimate collective FRRM. Care should be taken to ensure that the engagement by MSMEs resonates with the needs of the community, civil society, and political will. Second, policy interventions aimed at increasing the contribution made by MSMEs should be done carefully. A large number of experimental studies (e.g., FEHR & GÄCHTER, 2000a; NIKIFORAKIS, 2008) have shown that punishing free-riding can increase the willingness to cooperate. On the one hand, such pressure mechanisms might increase the willingness of firms that do not normally contribute. On the other hand, a reward system should be implemented in addition (e.g., tax reduction) for those firms that demonstrate a cooperative and prosocial strategy. However, policy instruments that publicize prosocial behavior might be a more promising approach to reward firms with a more public reputation (WORLD BANK, 2015). Third, sound institutions that foster the role of MSMEs as crucial social partners in the local economy should be strengthened. A reliable government or tax reduction programs for social commitment can encourage the firms' willingness to organize their business strategies in line with local needs. For instance, they may launch environmental or education programs that improve environmental protection and the education level of the residents. Fourth, the focus of

disaster risk reduction should also focus on second-tier cities. Compared with large cities, they more frequently lack international and national funding to reduce their exposure to natural hazards (BIRKMANN et al., 2016). Second-tier cities, such as Semarang, might be valuable places to apply a participatory governance approach for disaster risk reduction, where MSMEs and the community are empowered to choose and implement their own desired adaptation schemes.

Limitations and future research

In this article, we tried a novel approach that still bears limitations. Overall, the study should not be interpreted such that MSMEs' contributions to FRRM are the panacea to the challenges on effective disaster risk reduction. Rather, we attempted to stress that MSMEs should be integrated more into collective initiatives.

Our analysis used a simple scenario design with just five firms and a small neighborhood, and it can, of course, be argued that very few players would not be able to take on the burden of a large investment for a polder system. However, our main intention was to examine the underlying circumstances that determine the firms' willingness to engage in collective adaptation. The results should be interpreted accordingly. Future research should attempt to enlarge the setting to conduct the field experiment in a more realistic manner. However, the controllability of the setting should always be maintained so as not to blur the results.

Moreover, we excluded detailed information on the participants' characteristics (e.g., personal values, beliefs). Our main interest was in the cooperative behavior of MSMEs, and the scope of the experiments had to be restricted so as not to overtax the participants. Thus, we focused on firm-level characteristics. Because our participants were either the owner or operating manager, obviously their personal motives (e.g., risk behavior) also guide to a large extent the strategic decisions of the enterprise. However, replicated scenario-based field experiments should focus more on the individual level, particularly personal motives and values. This might reveal a more deciphered perspective on whether the firms' inherent characteristics or personal motives most influence the cooperative behavior of MSMEs.

Unfortunately, the analysis is unable to examine the impact of the institutional setting in detail as no statistical information is available. Therefore, the results should be interpreted with caution because they are based on the participants' personal assessments. The results might be biased because the participants answered according to the general social expectations. Therefore, it is further recommended first to conduct the field experiments with a control group and second to

conduct similar scenario-based field experiments in other natural and cultural settings to improve the external validity that is a typical weakness of field experiments.

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7 Concluding discussion

7.1 Theoretical and empirical contributions

The dissertation thesis aimed to enrich the literature by providing a more profound conceptual and empirical understanding of firms′ dual role in individual and collective adaptation. Furthermore, it endeavored to detect how firms′ flood adaptation strategies influence regional development. The contribution of this thesis is based on insights gained from research in the Indonesian flood-prone cities Jakarta and Semarang.

To achieve this objective and in order to answer RQ1, the thesis developed the conceptual framework, called IARD-framework that aimed to decipher the firm's decision-making on adaptation to environmental hazards. The conceptualization of the IARD-framework was based on the explorative insights from Jakarta and Semarang and an extensive literature review of various conceptual considerations of different disciplines (e.g., organizational studies, evolutionary economic geography, governance studies, and behavioral economics). Based on that, the IARD-framework suggests that firms fulfill with their flood adaptation strategies a dual role in shaping regional trajectories. First, it was argued that firms adapt individually in order to enhance their own competitiveness. This individual adaptation is utilized through routines and determined by the own risk behavior as well as the institutional setting. Second, it was postulated that firms act within a regional governance system that influences their collective adaptation. Based on both strands, the IARD-framework suggests that trajectories of regional development can be shifted along a gradient from collapse, resistance, resilience to transformation.

The explorative study of Jakarta and Semarang showed that the manufacturing firms′ individual adaptation relies on long-established routines. Collective adaptation is pursued barely due to low support by state authorities and a poor regional governance systems. With respect to the proposed different forms on IARD, it can be indicated that in Jakarta, the regional trajectory might change from resistance to resilience and to some extent to transformation. Large floods in 2007 and 2012 led to more engagement, particularly on individual adaptation. In contrast, a change of the regional trajectory could hardly be assumed in Semarang. The firms face difficulties to reconfigure their routines which endanger their viability. Hence, it has to be presumed that Semarang remains in a resistance stage close to a collapse in the mid-term future because a general enhancement on adaptation could not be indicated.

In sum, the IARD-framework provides for research on firms a novel systematization regarding their impact on regional trajectories. As proven by the explorative study on Jakarta and Semarang the proposed conceptual framework enables to consider the duality of firms′ decision-making on

adaptation (individual vs. collective). Furthermore, the framework highlights that the outcome of adaptation actions can lead to different outcomes on regional trajectories. Moreover, the IARD-framework emphasizes that firms′ adaptation strategies should be seen from different disciplinary perspectives. Especially, it is stressed to integrate theoretical considerations and empirical evidence from the behavioral economics that has been sparsely taken into account. Last, but not least, the IARD-framework invites researcher to validate the conceptual framework in order to deliver more meaningful research on how firms can foster an integrative adaptive regional development.

In order to gain a comprehensive view of the impact of flood exposures on manufacturing firms (RQ4), Chapter 4 and 5 outlined the direct and indirect business disruptions caused by flood events. These chapters have demonstrated that firms in Jakarta are less often affected by floods than firms in Semarang that are continuously exposed to tidal flooding. Nonetheless, the interviewed firms in Jakarta face substantial business disruptions as they are predominately confronted by large flood events.

Against the effort to decipher firms′ flood adaptation strategies (RQ2), the thesis conceptualized an extended typology of six flood adaptation strategies based on the conceptual ideas ‘routines’ and ‘dynamic capabilities’ from organization and business studies. The typology was tested empirically through the analysis of the 67 in-depth interviews in order to answer RQ5. In Chapter 4, the thesis contributes to the literature by showing that firms′ individual flood adaptation vary. These insights were further elaborated in Chapter 5. Based on the developed typology it has been highlighted that firms′ competencies and resource endowments determine whether firms are able to develop effective flood adaptation strategies. The case studies have shown that medium-sized and large firms with a considerable competitive advantage and/or a good endowment of resources and competencies were able to change their flood adaptation strategy toward a proactive one. In contrast to this, due to their limited competencies and a low level of competitiveness, SMEs have to rely on their reactive flood adaptation strategy or even surrender. The SMEs can barely alleviate their flood exposure. These results also answer RQ6. Differences concerning the business size were identified. Between both cities, two main differences could be detected. First, large floods in Jakarta caused firms to change their reactive flood adaptation strategy toward a proactive adaptation strategy. Permanent exposure to tidal floods resulted in firms in Semarang remaining rather reactive or even surrendering. Second, relocation was a much more desired flood adaptation strategy in Semarang than in Jakarta as tidal floods permanently affect the firms in Semarang. In Jakarta, relocation is rather determined by the spatial planning policy. Common to

both cities is that collective adaptation is barely pursued and that the support by the state authorities is very limited. These findings provide a deeper understanding of how firms′ relocation strategies are influenced by exposures to flood.

The thesis also contributes to a better understanding of why collective adaptation exists sparsely. Chapter 6 presented a novel methodological approach: The scenario-based field experiments that sought to disclose the rationales of MSMEs on cooperative behavior. The design of the scenario-based field experiments also answers RQ3. The scenario-based field experiments combined the basic assumptions of public goods games that are commonly applied in behavioral economics with the scenario design by vignette studies that originate from the social science methodology. This novel methodological conceptualization was applied to investigate the conditions under which MSMEs are willing to contribute to a collective FRRM. Based on 120 scenario-based field experiments, the study showed that 43 % of all participants were willing to provide a collective FRRM that will reduce the flood risk for themselves and their neighborhood. Findings from a multi-level analysis have shown that social motives and firms′ adaptive capacities have an essential explanatory power to state MSMEs′ willingness to participate in a collective FRRM voluntarily. Interestingly, MSMEs are willing to participate if a well-functioning governance system exists. Hence, the thesis contributes to the sparse empirical evidence on the cooperative behavior of MSMEs in the context of FRRM. However, the application of the scenario-based field experiments is not restricted to studies on FRRM. Therefore, scenario-based field experiments enable to better estimate the underlying factors of cooperative behavior within (local) governance systems and the voluntary contribution to a public good.

Regarding the impact of firms′ flood adaptation strategies on the regional development (RQ7), it can be indicated that the individual adaptation of large and to a certain extent of medium-sized firms in both cities took shifts towards a resilience phase and in some cases, the flood adaptation strategies start to transform. This can be especially indicated from Jakarta where large floods caused a turning point in state-led flood risk reduction measures. In Semarang, a substantial change of the regional trajectory can hardly be presumed. The firms rather accommodate the tidal flooding and their choice on flood adaptation strategies (proactivity and relocation) is limited due to financial constraints. This is especially true for MSMEs. Moreover, the interviews have shown that collective adaptation is barely pursued due to a poor regional governance system. The scenario-based field experiments also confirm this result. The participants in Semarang are more likely to contribute to a joint flood risk reduction measure.

In sum, it can be assumed that firms can induce a change of regional trajectories towards a more IARD. However, the thesis cannot provide a clear answer. Thus, research that captures the engagement of firms has to be continued. Possible research approaches will be outlined in section 7.2. Nonetheless, the thesis provides substantial empirical findings that allow deducing some understandings of the role of firms in enhancing regional development. The findings demonstrate that firms need sophisticated competencies and substantial resources to pursue more effective, proactive flood adaptation strategies that enhance their competitiveness. Firms with a higher level of competitiveness will also have possible impacts on regional development, for instance on creating more jobs and creating more tax revenues. Furthermore, firms that can develop effective flood adaptation strategies can act as a role model for other firms, the communities and the state authorities to establish a more IARD.

However, the findings also show that small firms struggle to develop effective flood adaptation strategies due to their inadequate competencies and limited financial sources. Poorly developed regional governance systems further constraint small firms on their ability to adapt to floods. Hence, they cannot fulfill more extensively their role as a backbone of the regional economy.

The thesis shows that the importance of a well-functioning governance system to enhance collective adaptation initiatives can also be detected through the scenario-based field experiments. The analysis based on MSMEs allows the conclusion that also small firms can a crucial player in collective adaptation. How the potential of firms, especially small firms, in supporting the state authorities and the community on adaptation to floods can be more unfolded is discussed in the following section. This section serves to answer RQ 8 and 9.

7.2 Policy implications

Based on the empirical findings, the following policy implications are derived that might lead to a more IARD:

First, the investigation on firms′ flood adaptation strategies has shown that particularly small firms can rarely adapt effectively to flood events due to limited financial resources and strong competitive pressure. A solution to improve the adaptive capacities of small firms could be the

implementation of a business continuity management. However, studies stress that SMEs commonly lack a business continuity management[38] (KATO & CHAROENRAT, 2018; DISASTER RECOVERY INSTITUTE, 2016). Therefore, it is suggested that state authorities, business associations or the chambers of commerce offer training programs and raise the awareness of business continuity planning tools. This might encourage SMEs to implement a business continuity planning in order to pursue a more proactive flood adaptation strategy. Business continuity planning can be also beneficial for the SMEs in order to improve their usually low level of competitiveness. An example of such training programs can be found in Singapore. Until April 2017, the government provided for SMEs a 70 % subsidy for training programs on business continuity planning. This training was offered by the Singapore Business Federation (SINGAPORE BUSINESS FEDERATION, 2018).

Second, since large and to a certain extent medium-sized firms are more proactive in developing effective competencies on flood adaptation, it is recommended that these firms share their knowledge with smaller firms. On the one hand, this might enhance the flood adaptation strategy of SMEs and consequently, their viability. On the other hand, large firms will be more actively involved in collective adaptation that might lead to a more IARD. Consequently, the entire manufacturing sector and even the small firms could better reduce their flood risk. Individual flood risk reduction measures could also be synchronized between the firms, for instance, within an industrial park where the authorities failed to implement FRRM. Moreover, the manufacturing factor could unfold their socioeconomic power and could contribute to a more advanced regional development with lower flood risk for the entire region. Within the project 'Global Initiative on Disaster Risk Management', between 2013 and 2018, the GIZ funded the initiative 'Strengthening Resilience of Small and Medium-sized Enterprises'. One part of this initiative was the strengthening of multinational firms′ support for SMEs in building disaster resilience. In Thailand, Indonesia and Vietnam, multinational enterprises offered assistance in implementing better disaster prevention measures. This voluntary engagement by the multinational enterprises sought to share their knowledge on business adaptation but also to secure their supply chains (ADPC, 2016).

[38] Business continuity management is defined as management processes that identify risks that can impact critical business processes (DISASTER RECOVERY INSTITUTE, 2016). It includes preventative measures, preparedness activities and response solutions (INTERNATIONAL LABOUR ORGANIZATION, 2011).

Third, the dissertation thesis detected that a sound collaboration between state authorities, the community, civil society, and firms is poorly developed in Indonesia; although formal regulations and laws on collaborative disaster management are well articulated. The in-depth interviews and the scenario-based field experiments pointed out that collaboration is desired but not well established. Thus, it is suggested to improve law enforcement and develop a more advanced multi-level governance system in which firms, particularly MSMEs, play an active part. The interviews with political stakeholders allow drawing the conclusion that engagement on flood adaptation is requested only by medium-sized and large firms because they are evaluated as profitable and corporate social responsibility should be a common practice for those firms[39]. Two shortcomings of this mindset are resulting in insufficient engagement by manufacturing firms. First, the interviews with large and medium-sized firms revealed that the firms do not want to be seen as a 'cash-cow' by the government. They rather want to be more actively involved in large-scale adaptation measures in order to share their expertise. Second, the group of small enterprises is oftentimes outside of the debate on collaborative FRRM. This is striking, on the one hand, since small enterprises are the backbone of the Indonesian economy, especially as a provider of labor and poverty reduction. Thus, their effective ability to alleviate their flood risk is also crucial for the socio-economic welfare. On the other hand, the scenario-based field experiments have shown that smaller enterprises show a higher willingness to contribute to a joint FRRM. Hence, it is recommended that smaller enterprises are more integrated into state programs on collective adaptation to floods. This is in line with contemporary reconfigurations of flood risk management that emphasizes the active engagement of residents in the conceptualization of FRRM (TSENG & PENNING-ROWSELL, 2012). In this respect, small enterprises might also be recruited as local stakeholders that execute and maintain jointly with the citizen local adaptation measures (e.g., pump houses). For instance, in the United Kingdom, 'Local National Partnerships' were established that bring together interested people, organizations, and firms that seek to improve the local adaptation to environmental hazards (CARTER et al., 2015; DEPARTMENT FOR ENVIRONMENT, FOOD & RURAL AFFAIRS, 2017).

Fourth, the thesis outlined that firms′ relocation plans are determined by spatial planning regulations in Jakarta. As part of the cities′ flood risk mitigation program, SMEs are forced to leave the river banks. Many medium-sized and large firms moved already to the suburbs. The moving to the suburbs continues and consequently, the land conversion toward industrial and

[39] This is also mentioned in the disaster management law (article 29 law 24/2007) (cf. GOVERNMENT OF INDONESIA, 2017).

residential areas affect increasingly natural water absorption areas. Jakarta might apparently reduce its flood risk, but new flood risk hotspots arise in the suburban areas. In Semarang, similar suburbanization pattern can be detected. The expansion of industrial and residential areas in the hilly hinterland – which is exposed to landslides – or toward the Western coastal peri-urban area, for instance, in Kendal[40] – which is exposed to floods – might aggravate the exposure to natural hazards in the area of Semarang. The regional development policy indicates that land-use planning is not synchronized with DRR-policy and vice versa. It seems that the urbanization, including the expansion of new industrial parks in hazard-prone locations, is apparently uncontrolled, or the short-term gains on tax revenues and foreign direct investment should outweigh the long-term negative consequences. It is very likely that the processes of high land subsidence rates and the reduction of water catchment will also occur in the newly developed areas. Due to its topography, Indonesia will always be exposed to floods. Therefore, the question is how the flood risk can be accommodated, or effective adaptation can be developed. Hence, it is recommended that the demand for more industrial and residential areas should be directed towards less risky areas. For instance, industrial parks could be built in less hazard-prone areas and connected via an efficient transport system to the harbor (HALLEGATTE, 2014).

7.3 Limitations and future research

This thesis provided profound insights on firms′ flood adaptation strategies, and it endeavored to detect its implication on regional development. Nonetheless, the findings hold some limitations that are presented in the following. Recommendations for future research are also proposed.

First, due to its explorative approach, the qualitative research is far from presenting a representative and complete collection of firms′ flood adaptation measures. Especially, a complete collection of adaptation measures could not be obtained. On the one hand, the firms have sometimes developed very firm-specific adaptation measures. It can be assumed that the firms in Semarang and Jakarta use more – probably even more effective – measures than the collected one. On the other hand, it is possible that firms did not disclose their entire adaptation strategies because they understand them as their ‘competitive advantage’ towards their neighboring firms that oftentimes produce the same good (e.g., clustered furniture firms in Semarang). The same limitations exist on the rationales of the pursued flood adaptation strategies. The decision-making, especially in

[40] In Kendal, 50 km far from Semarang, the Kendal Industrial Park (KIP) soft-opened in 2016. With more than 2,000 ha KIP is the largest industrial township project in Central Java. KIP seeks to attract 300 firms and 500,000 residents (KENDAL INDUSTRIAL PARK, 2018).

medium-sized and large firms, is divided between different departments or between the headquarters and the branch office. Thus, the interviewees were not aware of the entire decision-making processes that concerned the pursued flood adaptation strategy. Therefore, further research is suggested to gain a more deciphered understanding of the decision-making processes and the implementation of adaptation measures. It is suggested to follow an approach of single-firm case studies with a longer observation time and to conduct interviews with several firms′ decision-maker. These recommendations comply with methodological approaches that are commonly applied in organization studies. Such an approach might provide meaningful insights on firms′ decision-making of possible adaptation measures. Moreover, it could provide a more precise understanding of business procedures that are impacted by flooding, firms responses to different exposures to flood events and firms′ various adaptation actions.

Second, it might be possible that the actual threat of floods is higher than mentioned by the interviewees. When contacting the firms, it appeared that firms denied being exposed to floods. However, information from industrial park managers, local authorities or neighboring firms and own desk research on news articles on flood events lead to another conclusion. Hence, it is suggested to conduct a more comprehensive local analysis on a longer timeframe, for instance through remote sensing techniques (e.g., via unmanned aerial vehicles) in order to detect inundation and potential damage levels in industrial parks. So far, damage assessment analyses predominately focus on city levels or entire coastal areas (e.g., BUDIYONO et al., 2016). With regard to the interviewed firms, the analysis could not assess the exact effect of the pursued flood adaptation strategy on the performance (e.g., productivity, employment) in detail. Thus, a quantitative analysis as a follow-up study examining the impact of various adaptation strategies on performance indicators can reveal how flood adaptation influence the firms′ competitiveness. Combining remote sensing approaches with a survey might provide a profound flood impact assessment on the regional economy.[41]

Third, the sample solely comprises still active firms. During my field research, I was not able to conduct interviews with business owners of bankrupt firms. Thus, it could not be examined if firms had failed with their (mal)adaptation strategy. Therefore, it remains unclear whether flood hazards have a distinct impact on business failure. The statement by firms in Semarang and my field observation of abandoned places imply that due to the poor environmental conditions firms went bankrupt. Besides, it can be assumed that the number of firms that followed the relocation

[41] For instance, Willroth (2011) developed a vulnerability assessment model in order to quantify the impact of the Boxing Day Tsunami 2004 in Phang-Nga and Phuket, Thailand.

strategy might be higher. Tracing back relocated firms that are now probably located outside of the research areas requires a more quantitative approach of historical data about firms′ former location. This was outside of the scope of this study but would be a valuable approach to detect in more detail the influence of flood risk on regional trajectories.

Fourth, regarding the scenario-based field experiments, the problem of external validity should be considered. The obtained results cannot be translated automatically to other flood-prone areas, especially not to another institutional environment (e.g., developed countries) (AGUINIS & BRADLEY, 2014). However, additional scenario-based field experiments in a different flood-prone area (e.g., in Thailand or Vietnam) can enhance the external validity of the collected findings and test the usability of this novel methodological approach. In this respect, it is also recommended to include a control group that consists of participants that are not affected by flooding. Thus, it can be checked whether the obtained individual and contextual factors that determine the willingness to cooperate are typical characteristics within flood-prone settings. This thesis has not taken this into account.

Fifth, the proposed four directions of an IARD (cf. Chapter 3) could not be fully examined within the limited timeframe of this empirical research. Therefore, solely implications of directions were derived from the empirical research. Lately, engagement on flood adaptation and mitigation by governmental authorities, international NGOs and the private sector have experienced a new momentum. There has been significant progress, but in order to provide a clear indication of the directions, future research is recommended; this can comprise empirical research aligned with the proposed IARD-framework. In this vein, it is also suggested to apply the conceptual framework in other exposed coastal cities (e.g., Bangkok, Ho Chi Minh City) in order to test whether the firms' flood adaptation strategies resemble the findings from Jakarta and Semarang.

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Summary

Indonesia′s coastal cities are constantly affected by flooding. Urban expansion along with a land-use change accelerate the flood risk. In these typical flood-prone areas a high amount of manufacturing firms is located and thus very susceptible to business disruptions. Since the manufacturing sector belongs to the cornerstones of Indonesia′s economy, firms′ flood risk might endanger the hard-won increase of the past decades.

Therefore, this dissertation thesis contributes to the literature by elaborating firms′ role in adaptation on two perspectives: First, it is examined how firms utilize their competencies and resources in individual adaptation in order to enhance their competitiveness. Second, the thesis addresses the role of firms within a regional governance system and investigates firms′ engagement in collective adaptation that might support flood risk reduction at a local or regional level. It is argued that both perspectives combined might induce changes of regional trajectories that can take diverse forms (collapse, resistance, resilience, and transformation). The conceptual framework is applied in the two flood-prone cities Jakarta and Semarang.

Accordingly, the empirical research originates on two particular steps. First, a typology of six different flood adaptation strategies is conceptualized in order to systematize firms′ individual and collective flood adaptation strategies with regard to their business size and to compare both cities. The typology is empirically tested on 67 in-depth interviews with firms′ decision-maker. This research shows that large and medium-sized firms oftentimes pursue a proactive flood adaptation strategy, whereas small firms maintain their reactive or even surrendering strategy. Moreover, the interviews reveal that engagement on collective flood risk reduction measures remains low particularly of micro, small, and medium-sized firms. Therefore, second, a novel methodological approach, the scenario-based field experiments, is developed. The approach aims to reveal the firms′ individual and contextual factors that determine cooperative behavior in the context of the provision of a joint flood risk reduction measure. The results from field experiments with 120 representatives of micro, small and medium-sized manufacturing firms demonstrate that 43 % of all participants are willing to contribute to a collective FRRM. Furthermore, the study finds that the willingness of the enterprises is less motivated by self-interest, but rather by the interest in participating in a well-functioning governance system.

Regarding the impact of firms′ flood adaptation strategies on the regional development, there are signs that Jakarta is moving towards a resilience phase and the integrative adaptive regional development is starting to transform to some extent. In Semarang, the integrative adaptive regional development remains in a resistance phase with the threat to move to the collapse phase.

A complete evaluation of the conditions that manufacturing firms need to foster integrative adaptive regional development demands further research. This development is much needed in the dynamic setting of expanding urban development in flood-prone areas and thus firms′ increasing exposure to floods that is taking place in many countries of the Global South and not only in Indonesia.

Zusammenfassung

Die Küstenregionen von Indonesien sind kontinuierlich von Naturrisiken wie zum Beispiel Überschwemmungen betroffen. Urbanisierung und Landnutzungswandel erhöhen das Flutrisiko. In diesen Orten mit einem hohen Überschwemmungsrisiko hat sich eine hohe Anzahl an Industriebetrieben niedergelassen, deren Produktionsprozesse sehr anfällig gegenüber dem Überschwemmungsrisiko sind. Da der Industriesektor zu den Eckpfeilern der indonesischen Wirtschaft gehört, ist es möglich, dass hart erarbeitete Erfolge der letzten Jahrzehnte durch diese Exponiertheit von Industriebetrieben gefährdet sind.

Die Dissertationsschrift leistet einen Forschungsbeitrag, indem es die Rolle von Industrieunternehmen aus zwei Blickwinkeln betrachtet. Zum einen werden die unternehmerischen Fähigkeiten untersucht, die es den Industriebetrieben erlaubt individuelle Anpassungsmaßnahmen zu vollziehen, und dadurch ihre Wettbewerbsfähigkeit zu erhalten. Zum anderen betrachtet die Dissertationsschrift die Rolle von Industriebetrieben innerhalb eines regionalen Governancesystems. Es wird die Bereitschaft der Industriebetriebe untersucht sich an kollektiven Flutreduktionsmaßnahmen zu beteiligen. Es wird argumentiert, dass die Kombination beider Ansätze zum Wandel von regionalen Trajektorien mit ganzen verschiedenen Formen (Kollaps, Resistenz, Resilienz und Transformation) führen kann. Der konzeptionelle Rahmen wird auf zwei Städte, Jakarta und Semarang, mit einem hohen Flutrisiko angewandt.

Demzufolge war die empirische Forschung zweistufig. Erstens wurde eine Typologie von Flutanpassungsstrategien entwickelt, um eine Systematisierung der individuellen und kollektiven Flutanpassungsstrategien mit Hinblick auf die Unternehmensgröße vorzunehmen und beide Städte zu vergleichen. Die Typologie wurde an 67 Tiefeninterviews mit Entscheidungsträgern von Industriebetrieben empirisch getestet. Die Untersuchung hat gezeigt, dass Großbetriebe und mittelgroße Betriebe häufig eine proaktive Flutanpassungsstrategie verfolgen, wohingegen Kleinstbetriebe in ihrer reaktiven Flutanpassungsstrategie verharren oder sogar aufgeben. In einem zweiten Analyseschritt wurde ein neuer methodischer Ansatz, das szenariobasierte Feldexperiment entwickelt. Anhand diesem wurde untersucht, welchen Einfluss betriebliche Eigenschaften und weitere Aspekte des betrieblichen Umfelds auf die Bereitschaft von Mikro- und Kleinstbetriebe sowie mittelgroße Betriebe sich an einer gemeinsamen Flutreduktionsmaßnahme zu beteiligen, haben. Die Ergebnisse von 120 Feldexperimenten zeigen, dass 43 % aller Teilnehmer die Bereitschaft zeigen, sich an kollektiven Flutreduktionsmaßnahmen zu beteiligen. Ebenfalls zeigt die Untersuchung, dass die Betriebe weniger durch puren Eigeninteresse motiviert

sind, sondern vielmehr durch das Interesse, sich in einen gut funktionierenden Governancesystem einzubringen.

Hinsichtlich des Einflusses von Flutanpassungsstrategien auf die Regionalentwicklung lassen die Untersuchungen erkennen, dass Jakarta Anzeichen eines Wandels hin zu einer Resilienzphase zeigt und die integrative adaptive Regionalentwicklung sich teilweise zu einer Transformation entwickelt. Ein wesentlicher Wandel der regionalen Trajektorie lässt sich in Semarang hingegen nicht erkennen. Die integrative adaptive Regionalentwicklung verharrt in einer Resistenzphase, mit der damit einhergehenden Gefahr, einen Kollaps hervorzurufen.

Insgesamt zeigt die Dissertationsschrift, dass Industriebetriebe sich vor allem auf ihre individuellen Flutanpassungsmaßnahmen konzentrieren. Nichtsdestotrotz konnte gezeigt werden, dass Mikro- und Kleinstbetrieben sowie mittelgroße Betriebe bereit sind, sich innerhalb von gut funktionierenden Governancesystemen an kollektiven Maßnahmen zu beteiligen. Eine endgültige Bewertung, inwieweit Industriebetriebe eine integrative adaptive Regionalentwicklung fördern können, verlangt weitere Untersuchungen im Kontext des dynamischen Umfeldes einer zunehmenden Urbanisierung in Gebieten mit einem hohen Flutrisiko und damit einhergehend einer wachsenden Exponiertheit von Industriebetrieben gegenüber Überschwemmungen, welche in vielen Ländern des Globalen Südens und nicht nur in Indonesien stattfindet.

Appendix A: Supplementary material

Table A-1: List of interviews with manufacturing firms

ID	City	Sub-district	Main product	Business size	Origin	Date of interview
JDL-1	Jakarta	Cengkareng	Furniture	large	Domestic	2015-09-16
JDL-2	Jakarta	Cakung	Vehicles	large	Domestic	2015-10-01
JDL-3	Jakarta	Pulo Gadung	Pharmaceutical	large	Domestic	2015-10-06
JDL-4	Jakarta	Cakung	Garment	large	Domestic	2015-10-07
JDL-5	Jakarta	Cilincing	Metal products	large	Domestic	2015-10-13
JDL-6	Jakarta	Penjaringan	Metal products	large	Domestic	2015-10-21
JDM-1	Jakarta	Cengkareng	Wearing apparel	medium-sized	Domestic	2015-09-16
JDM-2	Jakarta	Cengkareng	Plastic products	medium-sized	Domestic	2015-09-17
JDM-3	Jakarta	Kebon Jeruk	Food-processing	medium-sized	Domestic	2015-09-28
JDM-4	Jakarta	Penjaringan	Electrical equipment	medium-sized	Domestic	2015-09-30
JDM-5	Jakarta	Penjaringan	Food-processing	medium-sized	Domestic	2015-10-02
JDM-6	Jakarta	Penjaringan	Plastic products	medium-sized	Domestic	2015-10-29
JDM-7	Jakarta	Cengkareng	Furniture	medium-sized	Domestic	2016-10-17
JDS-1	Jakarta	Kali Deres	Plastic products	small	Domestic	2016-11-23
JDS-10	Jakarta	Cengkareng	Metal	small	Domestic	2015-09-15
JDS-11	Jakarta	Cengkareng	Metal products	small	Domestic	2015-09-17
JDS-12	Jakarta	Penjaringan	Plastic products	small	Domestic	2015-10-27
JDS-13	Jakarta	Penjaringan	Plastic products	small	Domestic	2015-10-28
JDS-14	Jakarta	Tanjung Priok	Printing	small	Domestic	2016-10-11
JDS-2	Jakarta	Mampang Prapatan	Food-processing	small	Domestic	2015-08-26
JDS-3	Jakarta	Mampang Prapatan	Food-processing	small	Domestic	2015-08-31
JDS-4	Jakarta	Cakung	Wearing apparel	small	Domestic	2015-10-12
JDS-5	Jakarta	Mampang Prapatan	Food-processing	small	Domestic	2016-09-16
JDS-6	Jakarta	Mampang Prapatan	Food-processing	small	Domestic	2016-09-20
JDS-7	Jakarta	Penjaringan	Food-processing	small	Domestic	2016-10-13
JDS-8	Jakarta	Mampang Prapatan	Media	small	Domestic	2015-08-21
JDS-9	Jakarta	Penjaringan	Garment	small	Domestic	2015-09-01
JFL-1	Jakarta	Mampang Prapatan	Chemical	large	Foreign	2015-09-02
JFL-2	Jakarta	Cilincing	Vehicles	large	Foreign	2015-09-10
JFL-3	Jakarta	Cengkareng	Chemical	large	Foreign	2015-09-30
JFL-4	Jakarta	Cakung	Electrical equipment	large	Foreign	2015-10-15
JFM-1	Jakarta	Kelapa Gading	Chemical	medium-sized	Foreign	2015-10-01
JJL-1	Jakarta	Cakung	Vehicles	large	Joint-Venture	2015-10-21
SDL-1	Semarang	Genuk	Pharmaceutical	large	Domestic	2016-03-03
SDL-2	Semarang	Semarang Utara	Shoes	large	Domestic	2016-04-15
SDL-3	Semarang	Semarang Utara	Wearing apparel	large	Domestic	2016-04-21
SDL-4	Semarang	Semarang Utara	Wearing apparel	large	Domestic	2016-04-21

SDL-5	Semarang	Mijen	Motor vehicles	large	Domestic	2016-03-04
SDM-1	Semarang	Genuk	Electronic components	medium-sized	Domestic	2016-03-02
SDM-10	Semarang	Genuk	Cosmetic and soap production	medium-sized	Domestic	2016-11-02
SDM-11	Semarang	Genuk	Pharmaceutical	medium-sized	Domestic	2016-11-02
SDM-2	Semarang	Genuk	Printing products	medium-sized	Domestic	2016-03-03
SDM-3	Semarang	Genuk	Furniture	medium-sized	Domestic	2016-03-29
SDM-4	Semarang	Semarang Utara	Tobacco products	medium-sized	Domestic	2016-04-01
SDM-5	Semarang	Semarang Utara	Steel	medium-sized	Domestic	2016-04-19
SDM-6	Semarang	Genuk	Food-processing	medium-sized	Domestic	2016-04-20
SDM-7	Semarang	Genuk	Food-processing	medium-sized	Domestic	2016-04-20
SDM-8	Semarang	Semarang Timur	Metal equipment	medium-sized	Domestic	2016-04-29
SDM-9	Semarang	Semarang Timur	Tobacco products	medium-sized	Domestic	2016-04-29
SDS-1	Semarang	Semarang Utara	Furniture	small	Domestic	2016-04-27
SDS-10	Semarang	Semarang Timur	Spare parts for motorbike	small	Domestic	2016-04-28
SDS-11	Semarang	Semarang Utara	Paper products	small	Domestic	2016-10-26
SDS-2	Semarang	Semarang Timur	Wearing apparel	small	Domestic	2016-04-28
SDS-3	Semarang	Semarang Barat	Food-processing	small	Domestic	2016-04-19
SDS-4	Semarang	Genuk	Furniture	small	Domestic	2016-03-29
SDS-5	Semarang	Semarang Utara	Plastic products	small	Domestic	2016-04-01
SDS-6	Semarang	Semarang Barat	Metal product	small	Domestic	2016-04-19
SDS-7	Semarang	Semarang Utara	Printing products	small	Domestic	2016-04-21
SDS-8	Semarang	Semarang Barat	Textiles	small	Domestic	2016-04-25
SDS-9	Semarang	Semarang Utara	Food-processing	small	Domestic	2016-04-27
SFL-1	Semarang	Genuk	Pharmaceutical	large	Foreign	2016-02-29
SFL-2	Semarang	Genuk	Wearing apparel	large	Foreign	2016-04-11
SFM-1	Semarang	Tugu	Food-processing	medium-sized	Foreign	2016-03-30
SFM-2	Semarang	Genuk	Furniture	medium-sized	Foreign	2016-04-07
SFM-3	Semarang	Semarang Utara	Food-processing	medium-sized	Foreign	2016-10-28
SJL-1	Semarang	Genuk	Furniture	large	Joint-Venture	2016-04-07
SJM-1	Semarang	Ngaliyan	Food-processing	medium-sized	Joint-Venture	2016-04-11

Table A-2: List of expert interviews

Type of agency / organization	Institution	Location	Date of Interview
Business association	Disaster Resource Partnership	Jakarta	2015-03-26
Business association	Kamar Dagang dan Industri Indonesia (Indonesian Chamber of Commerce and Industry)	Jakarta	2015-08-21
Business association	European Business Chamber of Commerce in Indonesia	Jakarta	2015-01-09
Business association	Indonesia Business Council for Sustainable Development (IBCSD)	Jakarta	2015-03-09
Business association	Pelabuhan Perikanan Samudera (Fishermen Authority)	Jakarta	2016-04-10
Civil organization	Badan Pengelola Polder Banger Sima (BPPP SIMA)	Semarang	2016-04-27
Civil organization	Bintari Foundation	Semarang	2016-04-26
Governmental authority	Balai Konservasi Sumber Air Tanah (Groundwater conservation agency)	Jakarta	2016-03-16
Governmental authority	Kelurahan Tanjungmas	Semarang	2016-04-28
Governmental authority	Kelurahan Bandarharjo	Semarang	2016-04-29
Governmental authority	BPBD DKI Jakarta	Jakarta	2017-04-04
Governmental authority	BBWSC Ciliwung Cisadane	Jakarta	2017-06-04
Governmental authority	Public Works DKI Jakarta	Jakarta	2017-08-04
Governmental authority	Bappeda Kota Semarang	Semarang	2017-04-13
Governmental authority	BPBD Kota Semarang	Semarang	2016-03-03
Governmental authority	NCICD Jakarta	Jakarta	2016-03-16
Governmental authority	Kelurahan Rawa Buaya	Jakarta	2015-09-15
Industrial park management	Jakarta Industrial Estate Pulogadung (JIEP)	Jakarta	2015-08-27
Industrial park management	Permata Tangerang	Tangerang	2015-09-29
Industrial park management	Industrial Park Management Genuk	Semarang	2016-02-29
Industrial park management	Tanjung Mas Export Processing Zone (TEPZ)	Semarang	2016-04-21
Industrial park management	Kawasan Industri Wijayakusuma (KIW)	Semarang	2016-03-30
Industrial park management	Kawasan Industri Candi (Candi Industrial Estate Semarang)	Semarang	2016-03-31
Non-governmental organization	Dompet Dhuafa	Jakarta	2015-03-26
Non-governmental organization	Mercy Corps	Jakarta	2015-09-09
Scientific institute	Universitas Indonesia	Depok	2015-02-04

Scientific institute	Institut Teknologi Bandung - School of Architecture, Planning, and Policy Development	Bandung	2015-09-25
Scientific institute	Universitas Gadjah Mada - Faculty of Geography	Yogya-karta	2015-09-10
Scientific institute	Diponegoro University - Department of Urban and Regional Planning	Semarang	2016-01-03
Scientific institute	Diponegoro University - Laboratory of Geomatics and Planning	Semarang	2016-01-03
Service provider	Bank BRI Semarang	Semarang	2016-04-25

Question guideline for in-depth interviews

A) General information about the firm and the interview partner

1) Could you please give us a short overview of the history of your firm?
- Date of establishment and where? / How long do you work for the firm?
- Number of employees and offices / factories / subsidiaries in Indonesia (where?)
- Ownership (JV, foreign-owned, domestic)
- Products, market, supplier (How many? Where? Degree of global integration (i.e., relevance of local/national compared to international market/suppliers))
- Development in the last 10 years and future plans (e.g., expansions)
- Current market situation
- Since when is the business (unit) located at this site [name of area]?

2) Which responsibilities/functions do you have in the firm?

3) Have you changed the location of your business in the last 10 years?

If we know:
- Why do you have changed the location of your business in the last X years?
- What was the reason? (e.g., expansion, exposure to natural hazards)
- Which factors were important that influenced the choice of your new location?
- Are you satisfied with the decision?

If not: Why not?

4) Do you plan to relocate your business?
- What is the reason? (e.g., expansion, exposure to natural hazards)
- Do you know already where exactly?
- Which factors are important for you to consider the location choice?

If not: Why not?

B) Strategic decision-making

5) Which persons are responsible for the strategic and risk management in your firm? How are they involved in the strategic decision-making procedures? (tasks / functions)

Family business: Do you discuss business decisions with your family, other business people?

6) Do you have any medium or long-term investment ideas? Which are they (for instance human capital, technology, expansion, etc.)?

If not: Why?

7) Could please illustrate the steps of decision-making on an example, if you, for instance, buy a new machine or introduce a new product?
- Which people are involved? (power distribution among these decision-makers)
- What are the crucial steps?
- What internal / external factors do influence the investment decisions?
- Degree of spontaneity/flexibility

8) How are you facing business risks, e.g., decline in demand, stop of production

due to a broken machine?

- Which people are involved? (power distribution among these decision takers)
- What are the crucial steps?
- What internal / external factors do influence the decisions?
- Duration of the process (spontaneity / flexibility)?

9) Do you have established tools to reduce / shorten your decision-making within these management processes? Could you please describe them?

C) Impact of natural hazards on business

10) What risks had your firm to deal with in the past?
11) Do these risks affect your company solely or are other companies also affected (cross-sectoral or sector-specific issue?)? [Which others firms (supplier, competitor)?]
12) How did you handle these risks?
If not spoken about exposure to [named natural hazards] by himself / herself:
13) Do you talk with other managers or partners are [named natural hazards] a topic of discussion? What are the most frequently discussed issues on that regard?
14) Are natural hazards such as [named natural hazards] in general affecting your way of doing business? Are you more or less exposed in comparison to your neighborhood, to [Kecamatan] and to Jakarta/Semarang overall?
15) Is your business directly exposed to [named natural hazards]?

- To what extant?
- Which damages, problems did you experience in the past?
- How much are the costs of damage?
- Which part(s) of your business is (are) particularly exposed?

16) Is your business indirectly exposed to [named natural hazards], e.g., by infrastructure problems, supplier not able to deliver or the changing demand?
17) Which influence does the component of uncertainty due to [named natural hazards] playing your investment decisions? How do you handle it?
If not spoken about [named natural hazards]: How do you deal with the occurring uncertainty arising from flooding if you want to invest?
18) Do you think you can decrease your exposure to these natural hazards? If so, how?
19) Which are your information sources to capture the occurrence of [named natural hazards]?

- Are this information sufficient to enrich your knowledge?
- How do you extend your knowledge?
- If no assessment: How do you handle the uncertainty?

20) In your opinion, did the occurrence and/or magnitude increased or decreased in the past?
21) What is your expectation about the occurrence and magnitude of [named natural hazards] in the future? [Knowing, uncertain?] => Risk knowledge

D) Adaptation

Note: Adaptation is understood as strategic decisions as such protection measures or change of doing business

22) How did you adapt your business strategy due to the exposure to [named natural hazards]? Did this adaptation had an impact on your overall competitiveness? How effective do you think were your actions?
23) What measures are you planning to do continually in order to reduce that your business is affected, hence to enhance or improve your competitiveness?
24) Could you please give us an example of how a typical process of adaptation proceeds? => Modi of adaptation

- Which people are involved? (power distribution among these decision takers)
- What are the most important decision-making steps?
- What internal / external factors do influence the adaptation?
- Degree of spontaneity/flexibility: Duration of the process

25) How much money do you spend on adaptation measures? How many employees are taking part? (long-term or short-term adaptation measures?)
26) Do you consider your adaptation as sufficient? If not, what is lacking? What do you will change?

E) Collective adaptation

27) Do you take part in joint initiatives to reduce the risk by [named natural hazards]? What is your cooperation (scope of commitment, input of resources)? Which actors are involved?
- Who are they? (name, type of cooperation)
- Could you please explain the cooperation? (intensity, success)
- How are you involved in this cooperation? (initiated or invited?)
- Invited: How did you get involved? What is your contribution?
- Initiated: How did you engage the partner, stakeholder?
- What are the advantages / disadvantages of collaborating?
- Local, regional and national?

If no participation: Do you know initiatives / measures which aim to reduce the exposure locally, regional or nationally?

28) Do other actors (e.g., other firms, political institutions, NGOs) assist you to handle risks due to [named natural hazards]?
- Which actors are these?
- How important are they?
- Which role do they play?
- Have you learned from other actors to improve to deal with [named natural hazards]? What do you have learned to improve your, e.g., protection measures or kind of doing business?

29) If you have different opinions, how do you negotiate with the cooperation partners?
30) Which (further) steps / measures should be undertaken in the future? Why should they be undertaken? How urgent are they?
31) Will you take part to support these measures?
Yes: How will be your commitment?
No: Why not?
32) Who should be responsible for covering the costs for protection measures? Do you will support the funding of these protection measures?

F) Institutional setting

33) Which local, regional or national circumstances support your adaptation to [named natural hazards]?
- Political regulation (laws)?
- Procedure to extend your business (getting the permission)?
- Tax regulations?
- Infrastructure (electricity, water, roads, access to harbor / airport)?
- Access to credits, loans?
- Labor market?
- Environmental regulation?
- Cooperation with other firms, NGOs, political administration? (networks?) => assistance

34) Which local, regional or national circumstances hamper your adaptation to flooding and land subsidence?
35) How do you handle these disadvantages?
36) Which challenges is your firm confronted with in the future? How will you handle these?
37) Is there anything you want to add to our discussion?

Scenario-based field experiments

A) Risk game

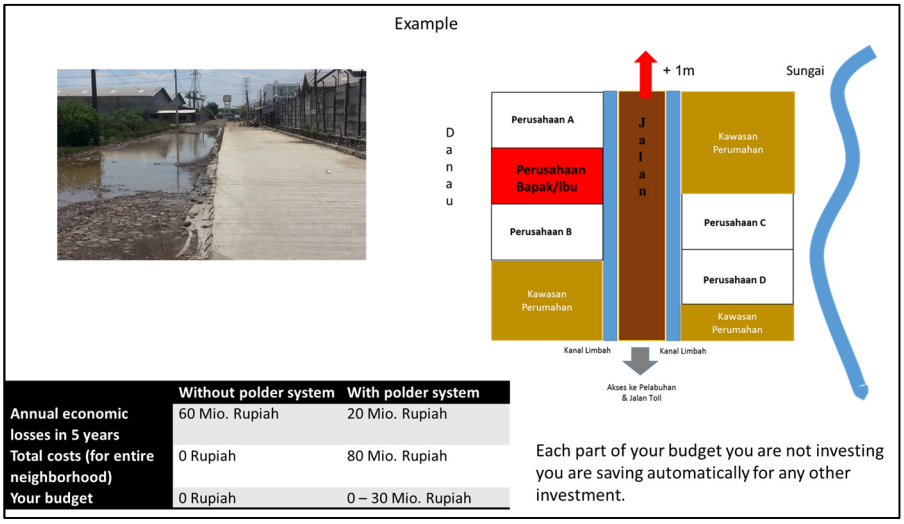
Situation:

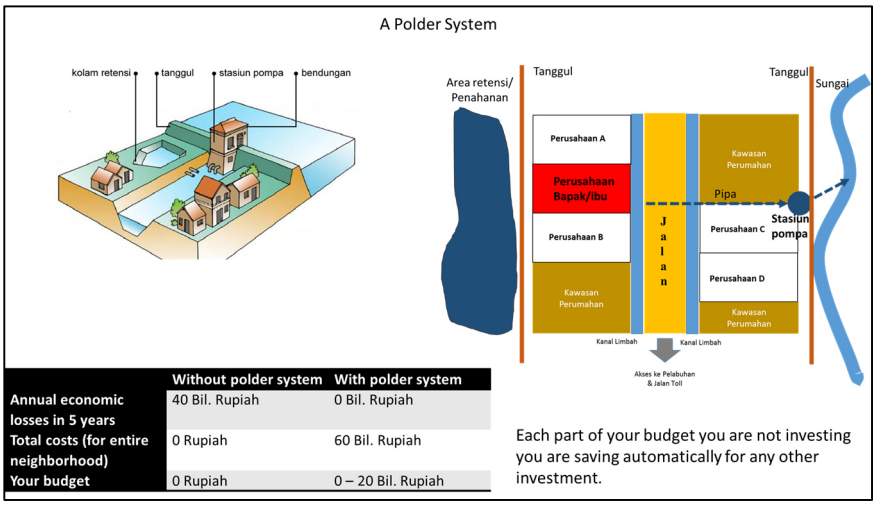
Your firm has a turnover of 20 Bil. Rupiah. You are only selling your product in Indonesia. Unfortunately, domestic demand is decreasing and the domestic competition is increasing. It will result in a certain net loss of 3 Bil. Rupiah. On the long run, it will threaten the survival of your firm.
There is the chance to improve your competitiveness by exporting your product. The export opportunity offers the possibility of great gains but may also result in significant losses.

Option A	Option B
Product export: with a 50% chance of making 6 6 Bil. Rupiah, and a 50% chance of losing 12 Bil. Rupiah	Do nothing: loss of 3 Bil. Rupiah

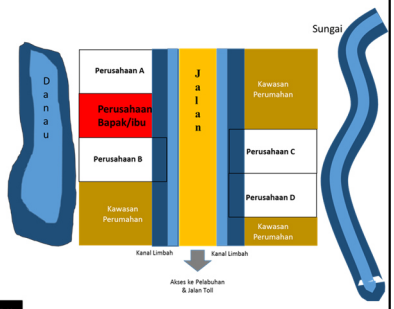
How do you decide?

B) Scenario cards





B Spatial planning & river expansion



	Without river expansion	With river expansion
Annual economic losses in 5 years	60 Bil. Rupiah	10 Bil. Rupiah (less production space)
Total costs (for entire neighborhood)	0 Rupiah	75 Bil. Rupiah
Your budget	0 Rupiah	0 – 25 Bil. Rupiah

Each part of your budget you are not investing you are saving automatically for any other investment.

C Sensitization

	Without sensitization programme	With sensitization programme
Annual economic losses in 5 years	4 Bil. Rupiah	1 Bil. Rupiah
Total costs (for entire neighborhood)	0 Rupiah	3 Bil. Rupiah
Your budget	0 Rupiah	0 – 1 Bil. Rupiah

Each part of your budget you are not investing you are saving automatically for any other investment.

C) Survey

Questionnaire

Please answer the following questions carefully. All your answers are kept strictly confidential and anonymous. It will not be possible to identify the participating companies.

A) General characteristics about the firm

1. What is the investment status of your firm?
   ☐ domestic ☐ joint-venture ☐ foreign
2. In which year was your firm founded? _____
3. Is the current location the same as in the year of foundation? ☐ yes ☐ no, former location _____ (kecamatan); year of relocation: _____
4. Is your firm planning to relocate?
   ☐ yes, new location: _____ (kecamatan) ☐ no
5. How many employees work in your company?
   Number: _____
6. Do more than 50 % of your employees live close to your firm (2 km radius)?
   ☐ yes ☐ no
7. How was the development of the number of employees in the last 5 years?
   ☐ increasing ☐ stable ☐ decreasing
8. How was the development of your turnover in the last 5 years?
   ☐ increasing ☐ stable ☐ decreasing

B) Flood experience and adaptation

9. How often did your firm experience direct exposure to floods within the last 5 years?
   Direct exposure to floods means that (parts of) the plant was inundated at least 30 cm.
   ☐ never ☐ 1-2 times ☐ up to 5 times ☐ up to 10 times ☐ more than 10 times

10. How often did your firm experience indirect exposure to floods within the last 5 years?
    Indirect exposure to floods means that the access route was inundated, the delivery by suppliers was disrupted, or the power was shut down.
    ☐ never ☐ 1-2 times ☐ up to 5 times ☐ up to 10 times ☐ more than 10 times

11. Has your firm undertaken preparations for floods within the last 10 years?
    ☐ yes ☐ no

If question 11 was answered with "yes"; otherwise please continue with question 13.

12. Does your firm use … for preparation for floods?
    a) Sandbags ☐ yes, since _____ (year) ☐ no
    b) Pumps ☐ yes, since _____ (year) ☐ no
    c) Uplifting street or (parts of) plant ☐ yes, since _____ (year) ☐ no
    d) Strengthen or heighten the walls ☐ yes, since _____ (year) ☐ no
    e) Emergency response team ☐ yes, since _____ (year) ☐ no
    f) Kerja Bakti (Cleaning the sewage system) ☐ yes, since _____ (year) ☐ no

13. Which protection scheme are you consider as useful that they are will lower substantially the flood risk? Please rate!

	Very useful					**Very u-seless**
	1	2	3	4	5	6
Pumps	☐	☐	☐	☐	☐	☐
Community Service	☐	☐	☐	☐	☐	☐
Polder System	☐	☐	☐	☐	☐	☐
Emergency Response Team	☐	☐	☐	☐	☐	☐

Sensitization	☐	☐	☐	☐	☐	☐
River Expansion	☐	☐	☐	☐	☐	☐
Uplifting the streets	☐	☐	☐	☐	☐	☐

14. In which of the following areas has your firm actively supported the local community?
    a) Ecological programs (e.g. waste minimization and recycling, pollution preventions, renaturation)
    ☐ yes ☐ no
    b) Social programs (e.g., poverty alleviation, education, health improvement)
    ☐ yes ☐ no
    c) Economic programs (e.g., infrastructure, support for entrepreneurship)
    ☐ yes ☐ no

15. Is your firm donating money or material (e.g., groceries, medicine) to flood-affected people?
    ☐ yes ☐ no

C) Cooperation

16. Does your firm cooperates with…

a)	Suppliers, customers (e.g. joint product development)?	☐ yes	☐ no
b)	Firms in the same district (kecamatan)?	☐ yes	☐ no
c)	Business associations, chamber of commerce?	☐ yes	☐ no
d)	Non-governmental organizations, international aid?	☐ yes	☐ no

D) Institutional environment

17. How would you rate…..?

	Very good 1	2	3	4	5	Very poor 6
Support of authorities getting permission (e.g. construction, production, export)	☐	☐	☐	☐	☐	☐
Support of authorities during flood	☐	☐	☐	☐	☐	☐
Access to loans, credits	☐	☐	☐	☐	☐	☐
Quality of infrastructure (electricity, roads, harbor etc.)	☐	☐	☐	☐	☐	☐
Law enforcement	☐	☐	☐	☐	☐	☐

Thank you very much for your support!

Fill out by interviewer

Location: _____ (Kelurahan / Kecamatan)

Industrial zone: ☐ yes ☐ no

Industry sector: _____

Appendix B: Own contribution

Article 1 (cf. Chapter Three) was co-authored by Javier Revilla Diez (University of Cologne) and Matthias Garschagen (United Nations University – Environmental and Human Security).
Article 2 and 3 (cf. Chapters Four and Five) were co-authored by Javier Revilla Diez
Article 4 (cf. Chapter Six) was co-authored by Maxensius Tri Sambodo (Indonesian Institute of Science – LIPI) and Javier Revilla Diez.

All articles are based on empirical data that has been collected during five research trips to Indonesia between March 2015 and April 2017. All research trips have been funded by the German Research Foundation (Deutsche Forschungsgemeinschaft) and the Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung).

I have contributed to the four papers in this dissertation in the following way:

- Review of literature relevant to the respective foci of the articles
- Development of the theoretical frameworks in all manuscripts
- Data analysis and processing of secondary data from the BNPB and BPS
- Selection and visiting local case-study regions in Jakarta and Semarang
- Conceptualization and modification of guideline questions for all in-depth and expert interviews
- Selection and contacting interviewees of 67 in-depth interviews, 31 expert interviews and 120 scenario-based field experiments
- Conducting all in-depth interviews, expert interviews and field experiments in collaboration with researchers from LIPI and Universitas Indonesia
- Cross-checking of all interview protocols and transcripts
- Independent analyzes of all interview transcripts, using MAXQDA
- Conceptualization and modification of scenario-based field experiments
- Data cleaning of field experiments
- Independent writing of all manuscripts
- Independent estimation of multi-level binary-logistic regression, using STATA
- Revision of all manuscripts under the guidance of Javier Revilla Diez (all articles), Matthias Garschagen (first article) and Maxensius Tri Sambodo (fourth article)

Appendix C: Eigenständigkeitserklärung

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

"Firms' adaptation strategies to floods and their potential implication on regional economic development – Insights from Jakarta and Semarang, 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. Javier Revilla Diez betreut worden.

Datum, Ort

Thomas Neise