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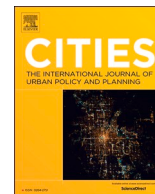
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Collective engagement as a navigational framework for urban resilience

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ABSTRACT

Collective engagement is an essential factor in building a resilient city. According to studies, while resilience strategies can lessen cities' vulnerability to disaster, their effectiveness depends on the cities' ability to execute them. Collective engagement helps to ensure the effective implementation of these resilience strategies. In this research, I examined collective engagement as a basis for strengthening, a city's resilience. Anchoring on the collective engagement urban resilience framework, I explore the links between collective engagement and urban resilience. Using an explanatory case study approach, I looked at the vertical, horizontal, and transverse links between collective engagement and urban resilience of two Dutch cities, Rotterdam and Dordrecht, and two Philippine cities, Marikina and Malabon. This research examines adaptive cycles in cities, including triggers, policies, and stakeholder collaboration. It contributes to the debate on cross-sector collaboration among stakeholders, which is essential for resolving issues and achieving common goals.

1. Introduction

The movement to build disaster-resilient cities began >20 years ago with the release of the Hyogo Framework for Action 2005–2015, followed by the Sendai Framework for Disaster Risk Reduction 2015–2030. These two policies emphasize the value of stakeholder participation, coordination, engagement, and inclusivity in disaster risk reduction and management and have been the basis for several other programs on building resilience. The first of these programs was the UNISDR “Making Cities Resilient” campaign in 2010, which aimed to construct disaster-resilient cities. >1000 cities and local governments participated in the campaign, pledging to make cities disaster resilient by sharing information solutions and best practices for dealing with disasters (UNISDR, 2012). Following the UNISDR campaign, The Rockefeller Foundation started the 100 Resilient Cities (100RC) initiative in 2013 “to help more cities build resilience to the physical, social, and economic challenges that are a growing part of the 21st century” (The Rockefeller Foundation, 2021). A City Resilience Framework and City Resilience Index were created to serve as the fundamental structure and guidelines for the 100RC members in making their cities resilient. In 2016 the Organization for Economic Cooperation and Development (OECD) released the Resilient Cities report and Framework for Cities. Both the 100RC and OECD frameworks emphasize adaptation and the interplay of social,

institutional, economic, and environmental factors as driving forces for developing a resilient city. Both frameworks highlight the necessity of stakeholder collaboration to maintain resilience.

Despite the emphasis on inclusivity and participation, research on collective engagement as a factor in the development or transformation of a city to become resilient is still lacking. Engagement occurs not just in formal state and government-led participatory processes, but also in self-organized actions or movements. Self-organization has always been important in building resilience (Adger, 2000; Davoudi, 2012; Gotham & Campanella, 2011; Marcus & Colding, 2011; Walker et al., 2004; Wilkinson, 2012) since it allows the community to better organize among themselves to enhance their overall well-being. Well within this premise, Esteban (2020) defined collective engagement as a “collaborative process [] characterized by having reciprocity, trust, and mutual respect between and among state and non-state stakeholders” (p. 5). This proposes that stakeholders (both government and non-government) collaborate in building a resilient city and seeking solutions to wicked problems. Collective engagement emphasizes that the responsibility for developing solutions rests not on one institution alone but collectively. Recognition and reciprocity foster trust, boost participation, and result in collective decision-making and action (Esteban, 2017). Collective engagement helps to develop ties between government and non-government stakeholders by appreciating each other's efforts. This

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produces mutually beneficial results and contributes to the collective good (Ostrom, 2014).

In this research, I sought to find the role of collective engagement in the process of building urban resilience by exploring the city’s flood (disaster) experiences, policies, and adaptive capacity. I centered my research questions on how collective engagement contributes to building urban resilience, what elements of collective engagement are present, and how they relate to the type of urban resilience experienced by the city. Through these questions, I examined how flood-prone cities used their experiences and adaptive capacities in building urban resilience.

In the next sections, I will discuss the conceptual underpinnings behind the research. This will be followed by Section 3 where I explain the method undertaken and the case cities selected. Section 4 presents the results and findings of the cases, followed by a discussion in Section 5. The final section presents the conclusions of the research.

2. Conceptual underpinning

Stakeholders’ participation and engagement is an exercise of democracy, empowering them to demand better services from the government and shape their collective identity (Momeni et al., 2011; Oduwaye, 2006; Moon et al., 2006). Their engagement in urban planning and development helps create solutions tailored to specific needs, raise the overall quality of these plans, and strengthen commitment to bring these services forward. However, not all forms of participation lead to these outcomes. An effective participatory process takes a deliberative approach, allowing stakeholders to debate, listen, dispute, and decide (Ansell & Gash, 2008; Gastil, 2000). It enables stakeholders to influence decisions that will impact their living conditions. This will only be effective if decision-makers are responsive and acknowledge the value of this collaborative process (Collier et al., 2013; Delli Carpini et al., 2004).

Understanding urban resilience is a complex process, as cities are both social and ecological systems. Recognizing these characteristics allows us to understand the procedural complexities involved in building urban resilience. To help navigate these complexities I use the collective engagement urban resilience (CEUR) framework which suggests that developing urban resilience may be accomplished through government and self-organization approaches (Esteban, 2020, 2022). The two approaches in the CEUR framework reveal that they both pass through a series of collective dimensions that meet in the middle, suggesting the mutual adaptation of stakeholder responsibilities in government and self-organization approaches (see Fig. 1). It emphasizes that to promote urban resilience, stakeholders in both approaches recognize the purpose of creating resilience for the collective benefit.

2.1. Drivers of resilience

The drivers of resilience are drawn from Esteban’s (2022) detailed systematic literature review of 364 articles screened at three levels resulting in the selection of 21 relevant articles. The systematic review culled out six criteria of resilient urban systems: (1) adaptive capacity and resilience to manage, adjust, learn and cope with different changes; (2) disaster preparedness, risk perception and awareness and recognition of disaster impacts at different levels and scales; (3) established enabling or supporting environments in creating a resilient city; (4) maintaining city resilience through diversity; (5) memory-based disaster experience; and (6) social, physical and economic drivers that contribute to household, community and city resilience (see Appendix A for the details). These criteria were further reviewed against resilience frameworks from practice. From here the five drivers of resilience were determined human, social, economic, institutional, and environmental (see Appendix B).

The drivers of resilience illustrate the complexity of cities, with each working as a separate yet linked entity that allows cities to function (see

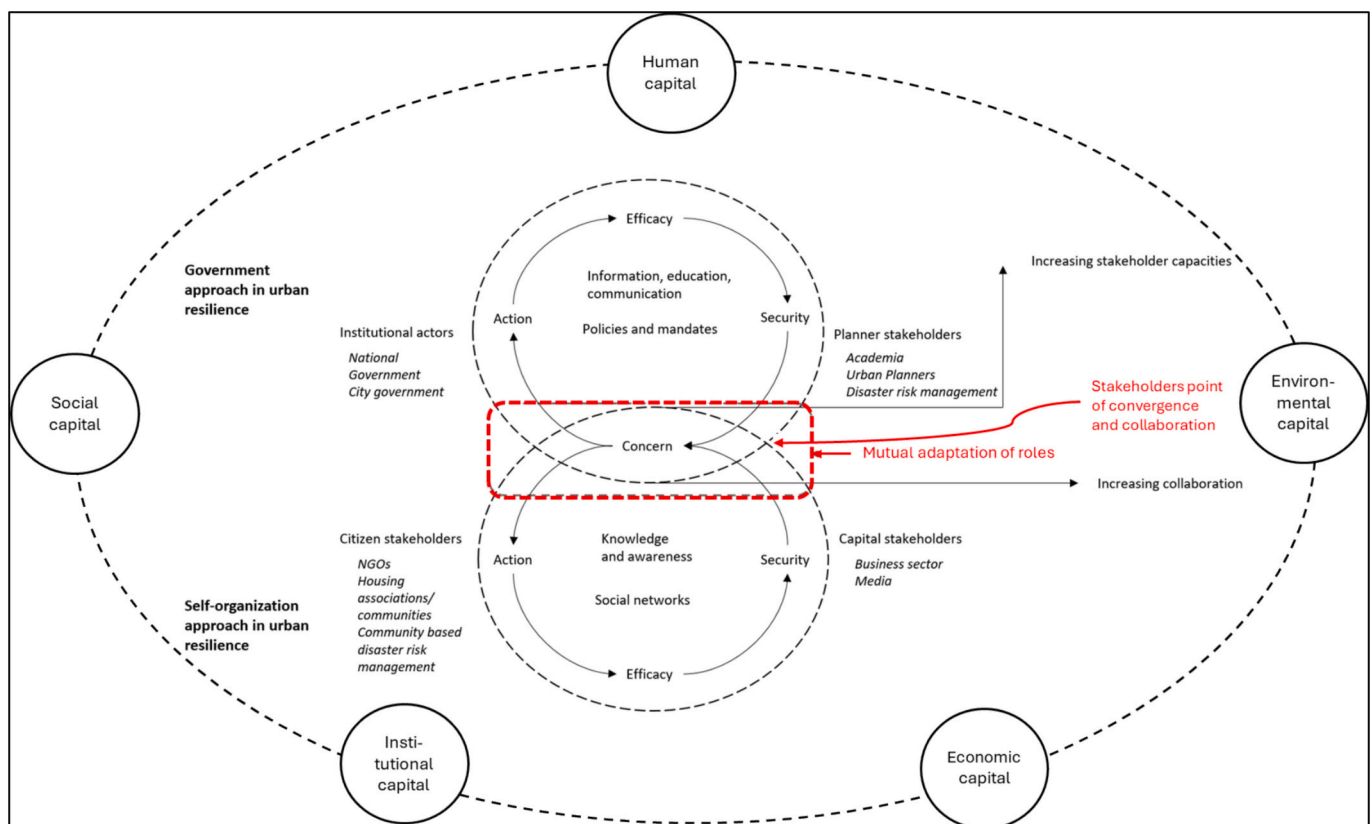


Fig. 1. Collective engagement urban resilience framework. Source: Esteban, 2020, 2022 (emphasis added by author).

Fig. 1). Cities use these drivers to adjust and maintain their operations before, during, and after crises. If each of the resilience drivers' capacity is low, it will take time to reach a state of equilibrium (resilience). Stronger resilience drivers are thus more likely to mobilize weaker resilience drivers to keep cities running smoothly. Memory and the demographic makeup of the population are key drivers of *human capital*. Memory, experiences, and local and learned knowledge influence how people perceive and react to threats. *Social capital* refers to a city's networks and ties. The elements that make up social capital may also be found in human capital, which helps to foster collective engagement, accelerate disaster recovery, and increase resilience. *Institutional capital* refers to government mandates or regulations that encourage collective engagement. It is also about the government's ability to utilize science-based solutions to manage natural hazards and build resilience. *Economic capital* fosters resilience by offering a diverse pool of resources that enable communities to function effectively in the face of disturbances. Diversifying economic growth sources improves the chances of sustained commerce and business. *Environmental capital* is the mix of a city's built and natural environments that aids in the mitigation of and adaptation to natural hazards. Cities may balance long-term prosperity with citizen safety and security by preserving the environment and developing infrastructure for climate mitigation and adaptation. In times of disruption, cities adapt and change across several periods and phases to achieve multiple equilibria, allowing them to experience periods of stability while gradually developing resilience.

2.2. Collective engagement and adaptive cycles

In the introduction, I defined collective engagement as a collaborative process involving various stakeholders to develop resilience-building measures. It is founded on understanding the various stakeholder responsibilities in the process. Fig. 1 shows that in the government approach, the stakeholders are the institutional actors and planners, while the self-organization approach includes the capital and citizen stakeholders. The CEUR framework's list of stakeholders is not exhaustive and different groups of stakeholders may exist depending on the city. However, the framework provides an idea of who is often engaged in the two approaches. The stakeholders in both approaches interact in the four collective engagement dimensions (concern, action, efficacy, and security) as shown in the arrows formed in a circular pattern. This refers to the adaptive cycles that systems go through that lead to change or transformation. In addition, Fig. 1 shows the circular pattern forming a standing lemniscate pattern, indicating that change, stability, collective engagement, and urban resilience building are ongoing processes rather than end goals.

Collective concern refers to the concern that stakeholders feel during a disaster. It comprises the desire to respond, organize, and learn from the disaster to prepare for future disturbances. Collective concern catalyzes action and is essential in building urban resilience. The next dimension, *collective action*, occurs when the network of stakeholders formed from the previous dimension can work together to generate solutions by encouraging the exchange of knowledge and experiences among stakeholders. The third dimension is *collective efficacy*, which occurs when a community feels empowered and actively participates in collective action to transform and improve their city. Communities that have better social control and cohesion may achieve collective efficacy more successfully. However, governments play a significant role in this dimension by creating an atmosphere conducive to engagement and participation. Finally, *collective security* refers to the sense of security that a city and its residents experience as a result of the government's provision of critical infrastructure for mitigating and responding to natural hazards. This involves frequent reviews and improvements to disaster response procedures, as well as the strengthening of human, social, economic, institutional, and environmental capital. Strong alliances and partnerships among stakeholders contribute to collective security.

In between the collective dimensions are the domains of change that facilitate the process of transcending from one dimension to the next (see Table 1). These domains of change are the bridges, knowledge, and boundary-spanning activities. Bridges facilitate collaborations across science, policy, and industry, translating issues into opportunities for renewal (Brown et al., 2016). It is closely connected to 'bridging' social capital which involves overlapping networks and inter-relationships, allowing networks to share resources and collaborate. Knowledge refers to knowledge gained through formal/informal learning and experience. It helps in understanding and providing informed decisions and addressing disaster concerns. Finally, boundary-spanning activities connect people, ideas, and resources to a common vision to increase urban resilience.

3. Methodology

An explanatory method was used in this research to establish patterns of how cities build urban resilience through collective engagement across the years. Analytical generalizations were constructed using these patterns, revealing transformation challenges and opportunities. I used multiple case studies to identify these connections, including overlaps, gaps, and discursive patterns. Multiple case studies are a suitable approach for explaining complex real-life situations and acquiring a thorough understanding of a phenomenon (Salkind, 2010; Simons, 2009; Thomas & Myers, 2015; Yin, 2009).

To build an empirically grounded case study the ideal number of cases should be between four and ten (Eisenhardt, 1989). In this research four case cities were selected, Rotterdam and Dordrecht in the Netherlands and Marikina and Malabon in the Philippines, to examine their approaches to building and strengthening urban resilience. The Netherlands and the Philippines have the highest vulnerability to natural hazards in the World Risk Index 2020. Despite both country's exposure to natural hazards, the Netherlands is among the least vulnerable, while the Philippines is among the most vulnerable (Behlert et al., 2020). The Dutch cities can provide insight into the organized structure of flood and disaster risk management, while the Philippine cases demonstrate how cities may spontaneously organize to establish order and resilience.

Both primary and secondary data were used in this research. Secondary data came from historical accounts (articles from scientific research, news, and city data), policies, disaster risk management data, and statistics. Primary data was collected through key informant interviews (KII) and focus group discussions (FGD) with city government officials, urban planners, disaster risk management experts, and other stakeholders. Table 2 shows the breakdown of interviewees. The KII and FGD semi-structured interview guide was designed to contain open-ended questions specifically addressing: (1) disaster experience, knowledge, and awareness; (2) self-organization and social networks; (3) policies and mandates; (4) collaboration and communication; and (5) urban resilience.

The results of the primary and secondary data were triangulated and processed using Atlasti software. To understand the systemic relationships at both the vertical and horizontal levels in building urban resilience four levels of analysis were done (1) the disaster experience(s), and the policies and activities (adaptive cycles); (2) drivers of resilience (adaptive capacity); (3) the collective engagement and urban resilience; and (4) the cross-scale interactions. For each city, the disaster experience, events, and policies were plotted in a timeline to understand the government and self-organization approaches as indicated in the CEUR framework. The second and third-level analyses used a qualitative scoring method to analyze the relationship between the drivers of resilience and collective engagement and urban resilience (see Table 3). Each score corresponds to a qualitative score description available in Appendix C. Assessment of collective engagement and urban resilience were based on the CEUR framework particularly, the perception of risk and resilience, influence of information and education, influence of

Table 1
Domains of change and transformation states.

Collective engagement dimensions	Domains of change			Transformation states
	Bridges	Knowledge	Boundary spanning activities	
Collective concern	Locally organized groups including volunteer groups, housing associations, community coalitions	Experiential knowledge, memory-based disaster experience, knowledge passed on to generations	Application of local adaptation measures	Remembering past disaster events, understanding and learning from past disaster events. Need to learn more and engage with networks.
Collective action	Local disaster risk management units	Experiential knowledge, common sense, technical knowledge, social interest and advocacy	Information, education and communication on disaster risk management	Awareness and understanding of disaster risks. The realization of stakeholders that collective effort is required to reach a level of resilience.
Collective efficacy	City disaster risk management office, economic diversity	Technical knowledge and expertise, social interest and advocacy	Regular disaster risk management drills and workshops, accessible information, education, communication campaigns through social media	Informed and educated stakeholders on disaster risk management
Collective security	National, regional, local (city) disaster risk management	Technical knowledge and expertise, social interest and advocacy, behavioural change	Information, education and communication on disaster risk management including existing climate and disaster proof infrastructures in the city	Mutual adaptation of roles of stakeholders in working towards resilience. Behavior change of people towards becoming disaster-risk aware reinforced through continuous information, education, communication

Source: Adapted Esteban, 2020, 2022.

Table 2
Stakeholders interviewed in the four cities.

Stakeholders	Rotterdam		Dordrecht		Marikina		Malabon		Total
	Offices/ Institutions/ Organizations	Count	Offices/ Institutions/ Organizations	Count	Offices/ Institutions/ Organizations	Count	Offices/ Institutions/ Organizations	Count	
Institutional Actors	Gemeente Rotterdam	9	Gemeente Dordrecht	6	Municipality of Marikina	4	Municipality of Malabon	8	27
	- Engineering - Urban management - Strategy advisor - Climate adaptation Waterboard		- City council - Crisis coordination - Lead planner - Water adaptation strategies Waterboard		- Marikina Disaster Risk Reduction and Management Office - City Planning Office		- City Planning Office - Housing and Resettlement Department - City Environment and Natural Resources Office - Malabon Disaster Risk Reduction and Management Office - Bureau of Fire Protection		
Capital	Urban design and architectural firm Port of Rotterdam	2	Port Authority	1	na	0	na	0	3
Citizens	Red Cross Resident Milieu Centrum Area committee Water Sensitive Rotterdam Head building association	6	Red Cross	1	Barangay* Council Members	6	Barangay Council Members Homeowners Associations	5	18
Planners	Landscape architect Delft University of Technology	2	IHE Delft Safety region Drechsteden Erasmus University Rotterdam	6	University of the Philippines Ateneo de Manila University Pamantasan ng Lungsod ng Marikina	4	University of the Philippines Ateneo de Manila University	3	15
Total		19		14		14		16	63

* *Barangay* refers to the smallest administrative unit in the Philippines, this is similar to a neighborhood.

social networks, and mutual adaptation of roles in disaster risk management.

Finally, the cross-case comparison was used to develop the discussion of the cross-scale interactions in the discussion part of this research. Using a comparative case study approach, which systematically compares two or more cases to analyze patterns of variations and similarities (Kaarbo & Beasley, 1999) I drew out the narrative from each case to find their unique stories as well as its links to the other cases. The city cases were subjected to within-case (single case) and cross-case (across cases) analysis to generate analytical generalizations. Within-case (single-case) vertical comparisons examined the policies that arose as a result of the

disaster experience, how the national government responded policy-wise, and how these policies were implemented at the city and community levels. Similarities and variations were extracted from each case narrative to identify the common drivers in the city’s transformation process to achieve a level of urban resilience. This cross-case analysis is critical for determining the causal link between the drivers of resilience and collective engagement.

Table 3
Quality of evidence rating.

Rating	Range	Level 1 scoring (drivers of resilience)	Level 2 scoring (collective engagement and urban resilience)
High	4 < 5	Drivers of resilience show evidence of the city's adaptive capacity	Collective engagement shows evidence of the contribution to urban resilience
Medium	2 < 4	Drivers of resilience show some evidence of the city's adaptive capacity	Collective engagement shows some evidence of the contribution to urban resilience
Low	0 < 2	Drivers of resilience show little evidence of the city's adaptive capacity	Collective engagement shows little evidence of the contribution to urban resilience

4. Results and findings

4.1. Adaptive cycles of the four cities

4.1.1. Rotterdam: Adaptive cycles in history

The Rotterdam case highlights a sustained economic focus on its urban development (see Fig. 2). It showed two adaptive cycles, the first triggered by the Rotterdam Blitz in 1940 and the Great North Sea flood in 1953, and the second based on near floods (riverine threats) in 1993 and 1995 and the pluvial flood in 1998. In the first adaptive cycle, both incidents required immediate response on the physical rebuilding of the city to restore its liveability and economy. The Great North Sea Flood prompted the Netherlands to ensure that a flood of this scale never occurs again through the creation of the Deltaplan and the construction of the Deltaworks project. This is the second point of departure for collective action to ensure flood risk security (see Fig. 2). The Deltaworks project took place concurrently with the port expansion in Botlek and Europoort, which turned Rotterdam into the world's largest port in the early 1960s.

As the port expanded and the economy grew, the demand for new housing stock prompted a shift in housing construction to the urban

fringes as greenfield developments. Political and social activists, on the other hand, opposed this, prompting the government to change its policy in its structure plan (*structuurplan*) to restore old buildings and locations with public involvement (Stouten, 2010). The location of new housing stock shifted from greenfield to brownfield mixed-use redevelopment areas. This signaled the beginning of the 1970s period of urban regeneration and renewal, as well as the involvement of private citizens in development planning. This is the first take-off point in the self-organization approach in the adaptive cycle (see Fig. 2), when activists in the 1960s recognized the need for a more inclusive approach to urban development, given how many government-driven urban regeneration efforts had occurred. The second take-off point of self-organization occurred in the 1970s and 1980s when environmental awareness in the Netherlands increased, as did membership in the largest environmental group *Natuurmonumenten* (Koppenol, 2014; Rijksoverheid, 2020). The port's expansion from Botlek, Europoort, and Maasvlakte I to Maasvlakte II raised concerns about increased air pollution from the blast furnace (in the 1970s) and general freight traffic (in the 1990s), prompting opposition from civil society, environmental organizations, and pressure groups (Koppenol, 2014).

The second adaptive cycle began in the 2000s, when several Rotterdam districts were affected by pluvial floods in 1998, prompting the city to acknowledge the need to strengthen its water retention capacity. It was also during this period when the national government shifted its water management approach from "working against water" (flood prevention measures) to "working with water" (climate change adaptation). As a result, laws such as the Flood Defence Act (1996), Room for the River (1997), and "Dealing Differently with Water" (2000) were enacted (Kaufmann et al., 2016). At the city level, policies such as Water Plan 1 (Water Plan Rotterdam 2000–2005) offered strategies to meet water management and urban development. The riverine flooding in 1993 and 1995, pluvial flooding in 1998, and the completion of the Deltaworks project marked the second adaptive cycle (blue curved arrows in Fig. 2), with more policies created since 2000 to address flood risk and climate change. These policies enabled cities to form alliances

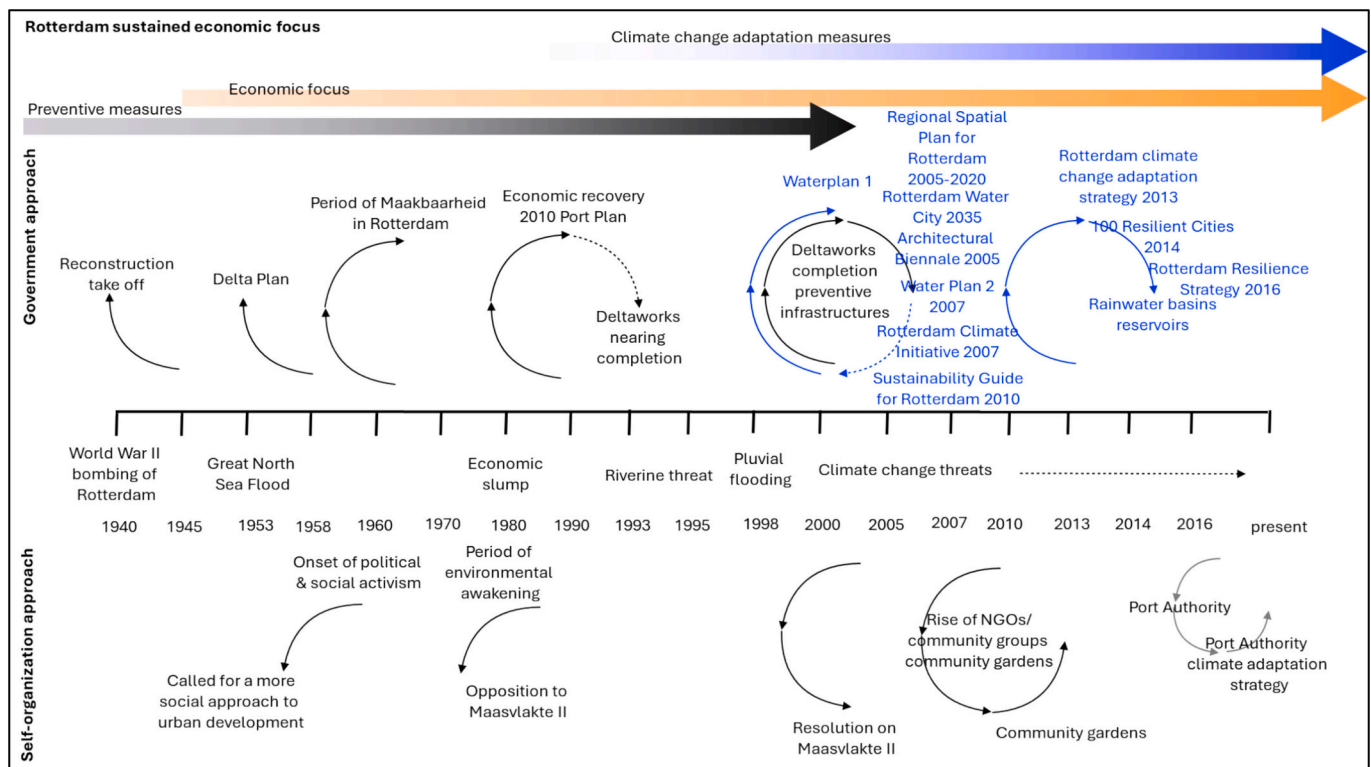


Fig. 2. Rotterdam adaptive cycles. Source: Esteban, 2022.

with various stakeholders to implement climate-adaptive initiatives.

Throughout the two adaptive cycles, stakeholders were more engaged in government-initiated initiatives in the 1960s, when housing and inclusion were in high demand, and opposed Maasvlakte II in the 1970s and 1990s. Stakeholders were vocal in the 2000s about the need for green spaces, resulting in the proliferation of community gardens around Rotterdam. However, there has been minimal interaction between stakeholders and the city government about climate change adaptation, flood risk management, and urban resilience.

4.1.2. Dordrecht: Adaptive cycles in history

Dordrecht’s adaptive cycle spans >600 years starting from the first and second adaptive cycles caused by the Saint Elizabeth flood in 1421 and the Great North Sea Flood in 1953, respectively (coded black under the government-approach in Fig. 3). The 1421 Saint Elizabeth flood changed Dordrecht’s landscape, while the 1953 Great North Sea Flood changed the Netherlands’ perspective on flood disasters, significantly impacting the Dutch’s collective memory. Dordrecht’s third adaptive cycle, triggered by riverine threats in 1993 and 1995 (shown in blue in Fig. 3), resulted in a series of flood risk management policies, plans, and studies in Dordrecht. This period also saw the introduction of the self-organization approach. Following the 1995 riverine threat, the Minister for Water Management called for a structural shift in flood risk management by the year 2000, allowing for additional river discharge space. This prompted the creation of the Room for the River policy, which sought to restore the old floodplains by creating a “room” for the river. The policy aimed to anticipate potential flooding while reducing its impact. Launched in 1996, it was followed by other policies and programs in the early to mid-2000s, aiming to restore floodplains and increase discharge capacity. The policy was a significant step in flood risk management.

The third and fourth adaptive cycles shifted from strong preventive measures to climate change adaptation strategies. These cycles began with multi-level governance research and programs, such as urban flood

management and Room for the River, and progressed to co-creation with the implementation of the multi-layer safety (MLS) approach, as well as innovative urban planning and spatial adaptation designs. Government collaboration at the national, regional, and municipal levels, along with technical experts and Dordrecht residents, has resulted in comprehensive urban plans and spatial designs that promote awareness, understanding, and open communication among stakeholders. The vision of the city to become a *zelfredzaam* island is communicated to the people.

The water board and dike army established a strong institutionalized approach to connecting with locals, making involvement in projects such as Room for the River more comfortable. Local and international collaboration such as the Managing Adaptive Responses to Changing Flood Risk in the North Sea Region (MARE) project aimed to demonstrate bottom-up flood risk management methodologies in four countries: the Netherlands, the United Kingdom, Germany, and Norway established local Learning and Action Alliances (LAAs) to create an integrated approach to addressing urban flood risk. The LAAs included cities, regional bodies, national authorities, academic institutions, and private partners (The North Sea Region Programme 2007-2013, 2009). The MARE program and the LAA resulted in flood risk management and urban planning policies in Dordrecht. The MARE program produced program reports synthesizing lessons learned from the four cities, focusing on the influence of LAAs on policy development promoting collaboration and bottom-up approaches in governance, climate change policies, and urban planning and spatial design. Fig. 3 shows the fourth adaptive cycle, coded green, that combines infrastructure and spatial design focus and collective engagement through the introduction of the MLS approach and the LAA.

4.1.3. Marikina: Adaptive cycles in history

Marikina City used to be one of the most flooded city in Metro Manila. In the 1970s Marikina not only experienced flooding caused by typhoons, but also by the river being silted, making it more difficult for water to flow freely towards the larger tributaries and eventually to

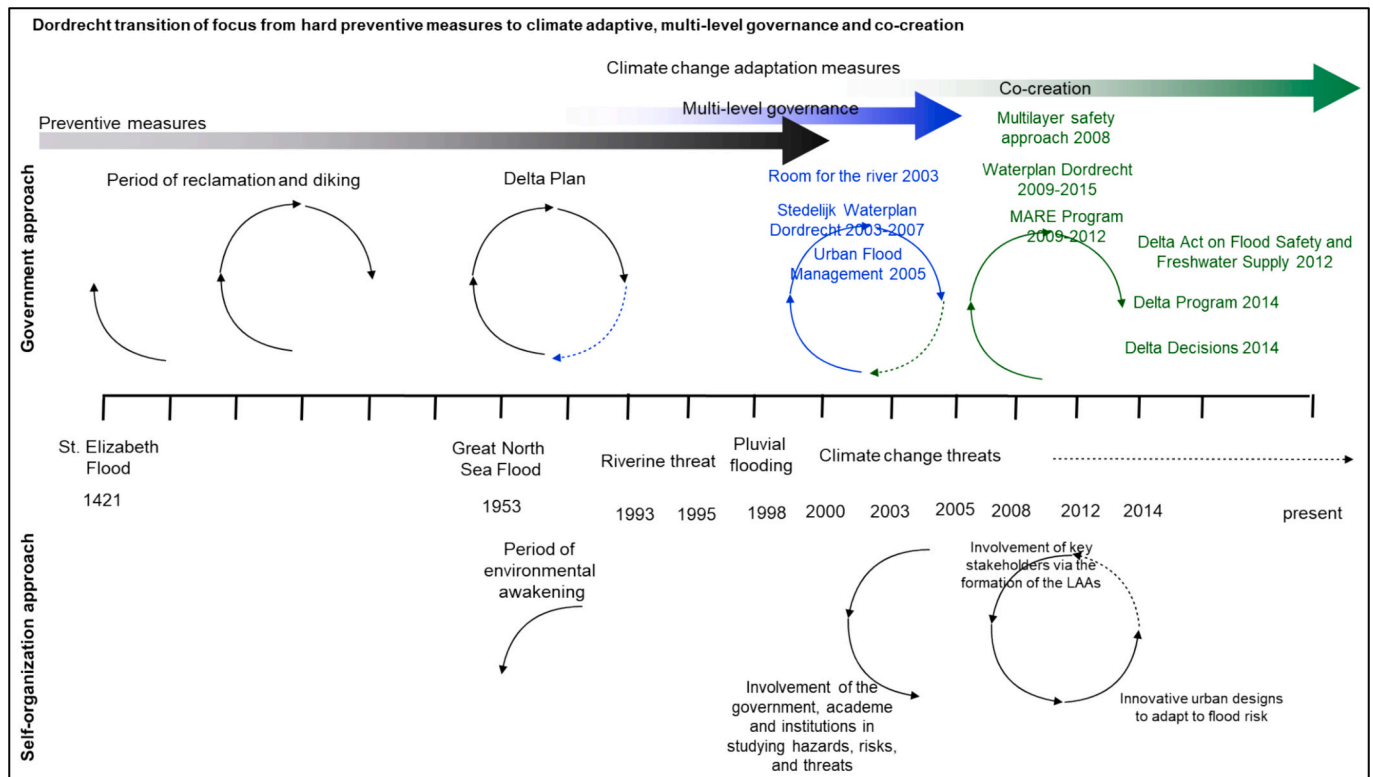


Fig. 3. Dordrecht adaptive cycles. Source: Esteban, 2022.

Manila Bay. By the 1990s, Marikina residents had become accustomed to regular floods due to overflowing river, crowded waterways, obstructions along river banks, and poor drainage systems. However, Marikina City has managed to turn things around and become one of the most progressive cities in the Philippines, driven by leadership, awareness, transformation, and partnership. The city's urban resilience process is divided into two adaptive cycles, the first adaptive cycle in 1992 (coded in black in Fig. 4) was triggered by a heavy typhoon that inundated 28 % of its land area. In the same year, a new mayor, Bayani Fernando (BF), took office with the intention to rehabilitate the Marikina River to reduce flood risk. The local government focused largely on the Marikina River rehabilitation program and immediately created two priority projects: "Save the Marikina River Program" and "Squatter-free Marikina." The BF administration established two departments to carry out the two projects sans city ordinances: the Marikina River Park Authority for the Save the Marikina River Program and the Marikina Settlements Office for Squatter-free Marikina. The two departments worked closely with the City Engineering Department to provide the infrastructure and engineering assistance needed to carry out the projects. A third initiative, Rescue 161, a 24-h communication platform for receiving emergency calls and dispatching medical emergency assistance was also launched. Marikina City was the Philippines' first local government to use such a platform, launching it in 1993. In 1998, the local government established the Disaster Management Office to oversee Rescue 161 operations and maintenance under Ordinance 264. This includes personnel salaries, equipment, and training.

In the first adaptive cycle, BF implemented changes using an authoritarian leadership style to transform Marikina from a laid-back town to a progressive city. His authoritarian approach earned him ire from many Mariqueños, but as the reforms contributed to improvements, people gradually changed their attitude. In the second adaptive cycle the new administration continued the projects that were started by BF, however, the leadership style became more transformational. The enactment of RA 10121 in 2010 gave the city the mandate to formalize Rescue 161 as the Marikina City Disaster Risk Reduction and Management Office (MCDRRMO) and to establish *Barangay* Disaster Risk Reduction and Management (BDRRM) units. Communities were given ample capacity to meet disaster risks through a budget for programs and projects in four thematic areas: disaster risk reduction, management, prevention, mitigation, preparedness, response, and recovery. The city also used information, education, communication campaigns to raise awareness on disaster risks at all levels. The interaction between the city government and the community has fostered unity, resulting in improved governance. However, floods in Marikina may continue if neighboring cities do not contribute to upland forest conservation and river system restoration, despite the city's successful projects, daily operations, and increased public awareness.

4.1.4. Malabon: Adaptive cycles in history

The final case, Malabon City, has one cycle spanning four decades, with the two approaches beginning at distinct timelines but converging between 2015 and 2020. The city has a long history of dealing with floods, as shown in Fig. 5, attempts at mitigating floods in Malabon have focused on installing flood gates and 'bombastic' (water pumps) until the national government initiated the large-scale CAMANAVA¹ Flood Control project. Feasibility studies for flood control facilities and infrastructure in the CAMANAVA area began in the late 1980s. In 1997, the CAMANAVA Flood Control Project was conceptualized and approved for implementation in January 1998 (Commission on Audit, 2014). However, the implementation of this project was delayed on several occasions and events in history. Esteban and Edelenbos (2023) provide a detailed explanation of the history of this project and how it affected

Malabon's urban resilience.

In 2010, per the mandate of RA10121 all local governments in the Philippines were required to create a disaster risk reduction and management office and establish the BDRRM units. In 2011, Malabon established the Malabon Disaster Risk Reduction Management Office (MDRRMO). That same year, Typhoon Nesat and Tropical Storm Haima caused major flooding in Malabon. In 2012, Habagat (southwest monsoon) flooded 90 % of the city, the shortage of equipment and personnel proved challenging for the city. Learning from the previous floodings, the local authorities organized the MDRRMO and developed a Disaster Risk Reduction Management (DRRM) Plan 2014–2024 to prepare for disasters.

Since 2015, the MDRRMO has worked with NGOs (non-governmental organizations) to deliver capacity-building initiatives at the *barangay* level. The NGOs played a key role in organizing and training communities, making them more prepared for disasters. By 2019, all 21 *barangays* in Malabon had established their own BDRRM units through the help of the NGOs. Fig. 5 depicts the timeframe and process of collaboration with NGOs, the growth of BDRRM units, and the Malabon community in the self-organization approach. One distinguishing feature of Malabon residents is their strong social capital. Because the city is densely populated and has few evacuation options, *barangays* have organized "adopt-a-family" and "adopt-a-*barangay*" evacuations. When the city floods, residents who own houses with second or third floors volunteer to 'adopt' their neighbors, while *barangays* with bigger evacuation spaces share it with residents from neighboring *barangays*.

4.2. Drivers of resilience and collective engagement

Rotterdam and Dordrecht are both rated high in terms of overall drivers of resilience, indicating high adaptive capacities in both Dutch cities. National-level policies such as the Deltaplan and Delta Act on water management form the basis of strategies and policies implemented by regional and local governments in the Netherlands. The translation of these policies at the city level depends on the cities' vulnerability to floods, flood experience, history, geological makeup, and priority. Rotterdam prioritized water retention in the 2000s due to the 1998 pluvial floods, while Dordrecht prioritized flood risk management due to increased risks to sea and river level rise. These experiences and characteristics show different levels of strengths in the cities' drivers of resilience. Tables 4 and 5, show the four cities' drivers of resilience and collective engagement scores.

Rotterdam's economic focus has been the primary force throughout its adaptive cycles, with the Port of Rotterdam at its core. The city has a robust government approach to urban resilience through its policies and initiatives particularly in marketing the city as an attractive place to live in, targeting mainly higher educated people. While the city's self-organization approach is developing, it requires broader acknowledgment as a collaborative opportunity. In contrast, Dordrecht's strong drivers of resilience are human, social, and institutional, rather than economic. Dordrecht's collaboration with the *waterschap* (waterboard), *veiligheidsregio* (security regions), academic institutions, and NGOs is visible in the initiatives they have completed and continue to work on regarding flood risk management. This connection to water and nature is deeply embedded in Dordrecht's culture and system, as seen by the city's activities, programs, and projects. The connection of Rotterdam and its residents is less compared to Dordrecht's such that the cities differ in the collective engagement scores. In Rotterdam, interviewees believe that the greater risk is the socioeconomic threat caused by low education, low income, and low social integration, which exacerbates the existing social and economic divide.

The environmental capital of both cities is rated medium. However, the rating is not exhaustive to assess the entire environmental capacity of the city but rather an indication of its ability to respond to flood risk. The Deltaworks' preventive infrastructure has significantly maintained security throughout the Netherlands. Despite the limited open space

¹ CAMANAVA is the acronym for the group of cities Caloocan, Malabon, Navotas, and Valenzuela.

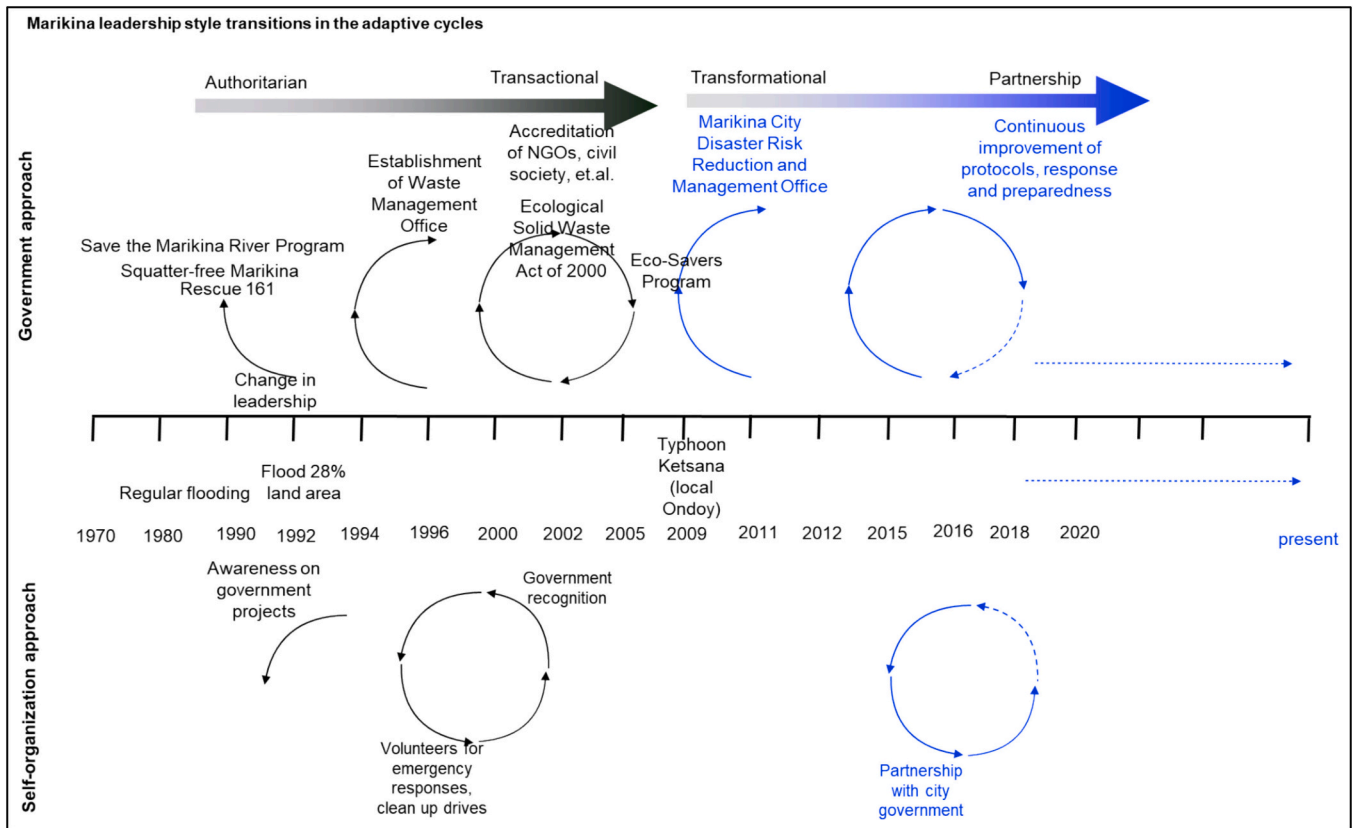


Fig. 4. Marikina city adaptive cycles. Source: Esteban, 2022.

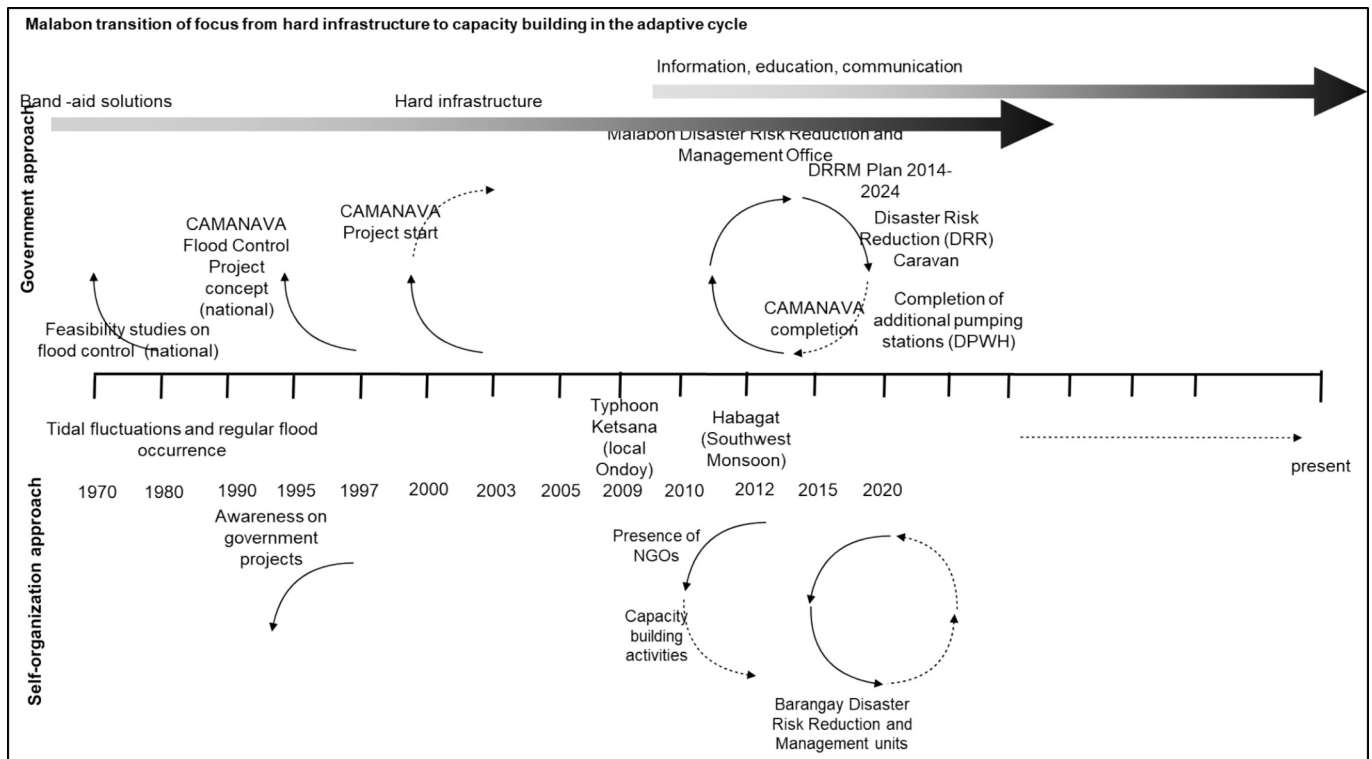


Fig. 5. Malabon City adaptive cycle. Source: Esteban, 2022.

Table 4
The four case cities drivers of resilience.

Case	Human Capital	Social Capital	Institutional Capital	Economic Capital	Environmental Capital	Rating
Rotterdam	(high) The Great North Sea Flood is generally recognized as a historical event that led to the construction of the Deltaworks. But the general risk awareness of the people is relatively low and confined mostly in areas that are frequently flooded such as the Noordereiland. Only the Port has a crisis plan.	(medium) There are organizations at the community and city level that are engaged in city development activities. Community organizations and non-government organizations have the chance to interact in city level initiatives such as the Water Sensitive Rotterdam. However, there is a social and economic gap in the very diverse population of Rotterdam.	(high) Rotterdam's policies on flood risk management and climate change are linked with the national government policies. Translation to the community level through activities are present in terms of infrastructure but vaguely understood at the level of the community.	(high) The contribution of the Port to the Netherlands GDP is at 6.2 % which is a significant amount considering the diverse industries the country has (Kuipers et al., 2018; Port of Rotterdam, 2018). Rotterdam is considered as the economic engine of Zuid Holland. Aside from the port, the city hosts numerous, international companies, financial institutions, industries, HORECA (hotels, restaurants and catering), among others. (European Commission, 2020)	(high) The Deltaworks system have since protected the country from impending flood danger. The city is also home to smart innovative climate adaptive structures. The total built up and semi-built up area in Rotterdam is 6335 ha or 63.35 km ² . This is 19.54 % of Rotterdam's total land area of 324.16 km ² . It's population density is 1923 persons per square kilometer.*	High
Dordrecht	(high) There is a level of risk awareness among the people in Dordrecht. Preparation is more prominent in the unembanked areas.	(high) There are close links between the city of Dordrecht and the Hollandsche-Delta waterschap. The Red Cross and the veiligheidsregio are also closely coordinated on the level of crisis management.	(high) Dordrecht's policies on flood risk management and climate change are linked with the national government policies.	(medium) Dordrecht's port is part of the Port of Rotterdam. While the Dordrecht part of the port is assumed to not be yielding the same amount of per capita income as the main port in Rotterdam it is assumed that it contributes to the Dordrecht's economy either directly or indirectly through employment.	(high) The Deltaworks system have since protected the country from impending flood danger. The city just like other cities are surrounded by dikes. Climate adaptive structures are present in the city. The total built up and semi-built up area in Dordrecht is 15.15 km ² . This is 15.23 % of Dordrechts's total land area of 99.47 km ² . It's population density is 1195 persons per square kilometer.*	High
Marikina	(high) The level of risk awareness and concern of the people is high. Preparation both at the community and city levels is high primarily due to the city government efforts risk awareness programs and projects.	(high) Marikina has a close tie up with the community, national government agencies and non-government organizations. The city is also in close collaboration with the Project Noah of the University of the Philippines.	(high) Marikina was the first to come up with an emergency service Rescue 161 in the Philippines. They pioneered a crisis management system before the national policy RA 10121. Led by a strongman in 1992 to fix the flood problem of the city through Marikina River rehabilitation.	(medium) Marikina is a highly urbanized city. While Marikina is considered a dormitory city there are number of industries and commercial establishments that contribute to the economy of the city.	(medium) There are no large scale flood preventive structures in Marikina rather the Marikina river has been widened and embankments strengthened. The river is also dredged regularly. The total built area in Marikina is 16.57 km ² or 77 % of the city's land area. Its population density is at 20,945 inhabitants per square kilometer.**	High
Malabon	(medium) The level of risk awareness and concern of the people is high. Flood is considered as part of the culture in Malabon.	(high) Malabon works closely with the community, national government agencies particularly the Department of Public Works and Highways and Metro Manila Development Authority. There are also non-government organizations that work with the city and the community.	(high) When RA 10121 was enacted Malabon created the disaster risk reduction and management office. This was followed by the community based barangay disaster risk management units.	(medium) Malabon is a highly urbanized city. It is home to a variety of industries most prominent are the fish processing factories and plastic manufacturing.	(low) The CAMANAVA flood control system is located in the city. It has several flood pumping stations. Malabon has a land area of 15.71 km ² and a population of 365,525. Its population density is at 23,267 inhabitants per square kilometer. The total built area in Marikina is 13.02 km ² or 83 % of the city's land area.**	Medium

Source: Esteban, 2022.

* Note: Data taken from www.cbs.nl

** Data taken from www.psa.gov.ph

available for evacuation in a flood, this preventive infrastructure decreases disaster risk and protects the inhabitants. The Deltaworks system has been trusted to prevent floods, and rightfully so, to the point where people no longer consider such floods to be possible.

"In the Netherlands, they trust the government. I think, in general [the

government] will do everything to protect [the people]. [The people] pay taxes for that." (Rotterdam citizen stakeholder 5, interview date 21 December 2018).

"People know that they are living below sea level ... They know that there are some risks but they are so convinced that we manage the risk that good

Table 5
Collective engagement and urban resilience.

Case	Perception of risk and resilience	Influence of information and education on collective engagement and urban resilience	Influence of social networks on collective engagement and urban resilience	Mutual adaptation of roles in disaster risk management	Rating
Rotterdam	(medium) Social-related threats are higher than possible floods. Varied interpretations of resilience.	(medium) Information and education on the historical flood disaster is present. Local knowledge and adaptation measures are limited in areas frequently flooded such as the Noordereiland.	(medium) Social networks on DRRM is not present. There are community organizations and non-government organizations but not on DRRM.	(medium) Non-government organizations working with the community are recognized by the local government. Only the Red Cross has a set of volunteers that can be tapped during a crisis (Ready to Help).	Medium
Dordrecht	(high) Risk of floods higher in the historic city center than the rest of the city. Perceive resilience according to the concept of DRRM which is prevention, preparation and recovery. Creating alternative solutions and decrease vulnerability.	(high) The LAA exists in Dordrecht where knowledge and information is shared among the stakeholders. Regular vloedschotten and sand bag exercise attended by the community. Regular information dissemination during storm season.	(high) Existence of LAA and 'safety team'. Close coordination between city government, <i>waterschap</i> and <i>veiligheidsregio</i> on information dissemination activities.	(high) Ready to help from the Red Cross is active and well recognized. The city government has an organized 'safety team' who work closely with <i>veiligheidsregio</i> , police, and fire brigades.	High
Marikina	(high) Have a shared understanding on key threats. Perceive resilience as " <i>katatagan</i> " (stability) and " <i>kaalaman</i> " (cognition) two words used to describe the strength to rise up from adversity through awareness and knowledge.	(high) Disaster risk awareness and DRRM activities are disseminated at all levels. Schools include DRRM activities and courses. Regular trainings provided.	(high) Social networks are present including non-government organizations. Academic institutions have direct engagement with the community. Use of social media is high in communicating with the city government.	(high) <i>Barangay</i> disaster risk management units are present and prepared. The city government works closely with the BDRRM.	High
Malabon	(medium) There is a general understanding on the risk to floods. Resilience is perceived to be anchored on 'survival thinking' or the need to survive.	(high) Disaster risk awareness and DRRM activities are disseminated at all levels. Regular trainings and drills provided.	(high) Social networks are present including non-government organizations. Adopt a <i>barangay</i> and adopt a family evacuation strategy. Use of social media is high in communicating with the city government.	(high) <i>Barangay</i> disaster risk management units are present and prepared. The city government works closely with the BDRRM.	High

Source: Esteban, 2022

that they hardly think about it." (Dordrecht institutional actor 6, interview date 24 January 2019).

In the Philippine cases, reliance on the government's role to keep both cities safe from flooding is limited. In Malabon, where the flood control facility is located, the national government, through the Department of Public Works (DPWH), is expected to maintain the infrastructure. However, Malabon's *barangay* leaders and residents take on the responsibility of fixing and maintaining flood gates and pumping stations, as it takes time for the DPWH to do so. Both city governments of Malabon and Marikina recognize the community's role in disaster risk reduction efforts. In Marikina, the city government fosters a partnership between the government and the community to face adversities during the typhoon season. This mutual adaptation has resulted in practical localized solutions in both cities.

"Our command center is on Facebook live. Why do we do that? We do it for [the] people in Marikina to let them see that the operations center is working 24/7 and that they can call us anytime ... not all LGUs embrace social media because they are afraid that it will be used against them politically. If a city official gets bashed, the elected official, their careers are over. But here in Marikina we embraced it. We use social media to our advantage and true enough it made communication with the people much easier ... Because if you don't inform the people they will be afraid, if you inform them they will also be afraid but then they can prepare." (Marikina institutional actor 1, interview date 13 March 2019).

"For people to survive we also came up with a community savings group, a livelihood that they don't have to rely on the *barangay*. In case of calamities they have savings that can be used for a day to seven days ... they have to have the capacity to rise up from the disaster that they don't have to rely on others even if there are a lot of people helping. It is better to have your own savings, to have their own capacity to bounce back." (Malabon citizen stakeholder 1, interview date 15 March 2019).

With the passage of RA10121, both cities were able to establish their own DRRM offices giving them a budget for operations on disaster

preparation, response, and recovery, as well as capacity-building activities. The city also provides information on environmental issues like pollution and river clean-up, empowering stakeholders to contribute to flood mitigation through cleanliness and proper waste disposal. This has strengthened the cities' institutional capital and also contributed to enhancing the human and social capital. Marikina and Malabon have medium and low environmental capital, respectively. Both cities have a population density of >20,000 people per square kilometer, putting the residential population at risk in the event of a large-scale disaster; however, Marikina is ranked higher because flooding occurs less frequently than Malabon due to Marikina's river cleanup and periodic dredging, which helps reduce flood incidents.

Table 4 shows that Marikina's resilience drivers are high, owing to the city's strong institutional, human, and social capitals, built on strong leadership and reforms implemented during the first adaptive cycle. The trust that the city government of Marikina earned from the residents over the years through its transformation evolved into a partnership between the city and the residents resulting in the mutual adaptation of their roles in disaster risk management.

Malabon, on the other hand, may have preventive infrastructure in place, but the city's strength stems from its residents' strong adaptation to the frequent floods that they experience. The city partnered with NGOs to help with various activities by the MDRRMO which includes awareness campaigns. Still, it is the social capital that remains strong in Malabon where communities self-organize to facilitate creative and unconventional evacuation strategies. The strong social capital of both cities and connections with the residents are also evident in the high scores under collective engagement as shown in Table 5.

5. Discussions

In this research, I looked at how collective engagement helped cities build urban resilience following disasters. The research shows that all

four cities adopted a command and control strategy at the onset of a disaster. This strategy is necessary to maintain order during crises (Jahangiri et al., 2011; McSweeney & Coomes, 2011; Romero-Lankao & Gnatz, 2013). The flood disaster experiences prompted the national and local governments of the case cities to develop policies that promote measures to mitigate or adapt to such disturbances. In the Netherlands, the 1953 Great North Sea flood resulted in the Deltaplan; in Marikina, the 1992 typhoon and flooding prompted reforms by the new city administration; and in Malabon, the 2012 floods caused by monsoon rains accelerated the formation of MDRRMO. These findings underline the significance of the government’s role in disaster management especially at the onset of the disaster.

Policies in each of the case cities demonstrated a shift from preventive infrastructure or an engineering focus to climate change adaptation and participation. This was much more prominent in the Dutch cases where the transition from preventive infrastructures to climate change adaptation and participation led to significant changes at the local level. The Dutch government introduced a climate-adaptive approach to flood risk management in the late 1990s, which became the urban and spatial planning guidelines of Rotterdam and Dordrecht. Because of the coordinated framework of flood risk management and crisis management, the two cities exhibit comparable patterns of collective engagement and urban resilience. However, the implementation of these rules at the municipal level is customized to the city’s development goal. Rotterdam’s economic focus tended to have a management-style governance, which has an impact on the collective engagement process. Interactions between institutional actors and planners, capital stakeholders, and citizens are regular and two-way, (as indicated by the two-headed arrow broken lines in Fig. 6), while interactions between institutional actors and citizens are not regular or at times one-way. Dordrecht, on the other hand, adopts a robust and inclusive approach to achieve its vision of a *zelfredzaam* island.

Dordrecht’s *zelfredzaam* vision, which translates to self-reliance, does not imply that the city accomplish everything on their own. It means acknowledging that achieving such a vision necessitates maintaining an active network of actors and raising disaster risk awareness. It is widely acknowledged that a resilient city necessitates a combination of factors, including a network, risk awareness, and policies that are readily accessible and understood by all stakeholders. The city’s self-organization approach, which includes interdependent activities across stakeholders, demonstrates how technical approaches to climate

mitigation and adaptation can be linked with community engagement and learning. Dordrecht, like Rotterdam, benefits from the Deltaworks system and compartmentalized diking system; but, the city’s long-standing collaboration between the municipal administration, waterschap, and community has made it both physically and institutionally strong.

The research showed the process of collective engagement varies across time and scale, influenced by governance mechanisms, trust, and leadership. The Marikina case is unique in this regard as it created a disaster risk management office before the national government mandated its creation. This highlights the potential of a city with strong institutional capital, leadership, and foresight to enact change. However, caution should be taken as the authoritarian approach at the beginning of the reforms in Marikina was met with criticism and lawsuits against the mayor. The success of this approach may depend on the actual benefit experienced by the residents. Here the importance of mutual adaptation of roles is highlighted.

The research showed that a dependable government and flood and disaster risk management system fosters trust and accountability; however, relying on a very successful flood prevention infrastructure (Dutch cases) can result in a long disaster gap, making it difficult to engage stakeholders in disaster risk management initiatives. This is known as the ‘levee effect,’ a false sense of security (Baan & Klijn, 2004; Collenteur et al., 2015; Hutton et al., 2019) that is exacerbated by a long disaster gap and reliance on the government’s responsibilities to care for citizens. This also reduces flood risk perception and awareness (Slovic, 1987; Terpstra, 2011).

In the Philippine cases, the decentralized flood risk management approach helps create social and community resilience, allowing self-organization to be nurtured, however, this might lead to band-aid measures (Malabon case). On the other hand, Marikina demonstrates vertical, horizontal and cross connections of stakeholders in Fig. 7 as shown by the two-headed arrows representing the city’s focus on partnering with its stakeholders. This facilitates direct collaboration among stakeholders at all levels. Marikina’s policies on participation and education helped build this partnership.

The findings suggest that cities that engage directly with stakeholders in discussions, programs, or drills have higher collective engagement on disaster risk management. Regular information, education, and communication contribute to improving disaster awareness (Esteban et al., 2015; Ling et al., 2022). In Dordrecht and Marikina, the

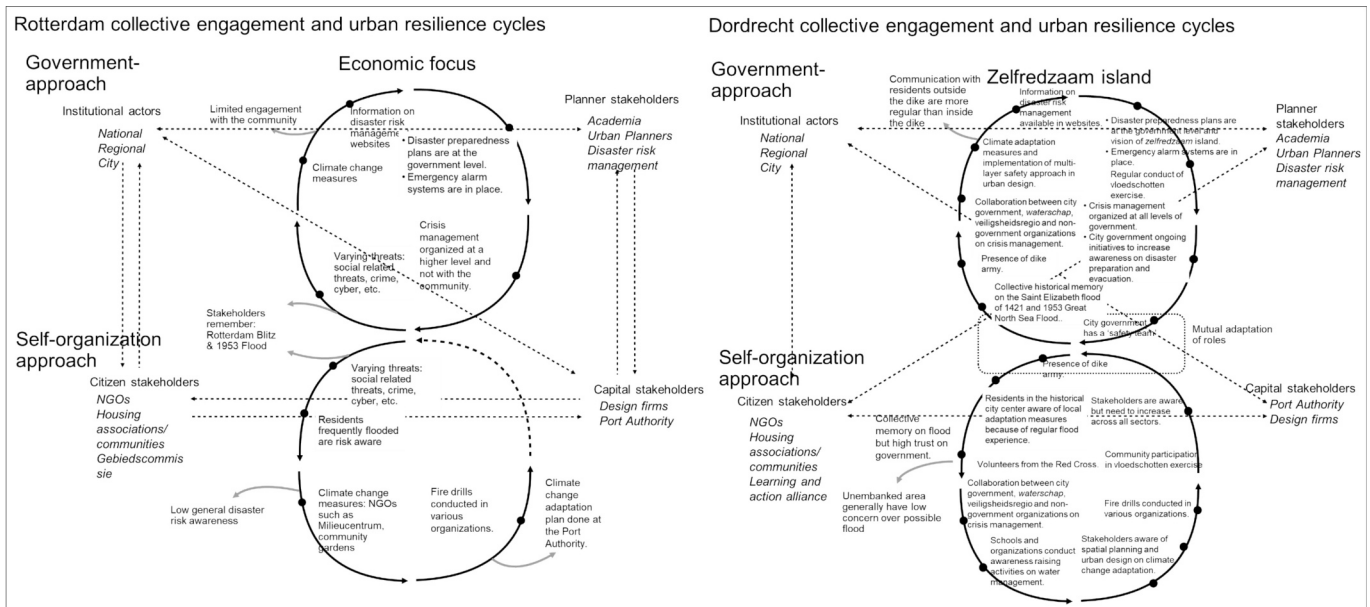


Fig. 6. Summary of Rotterdam and Dordrecht’s process of collective engagement and urban resilience.

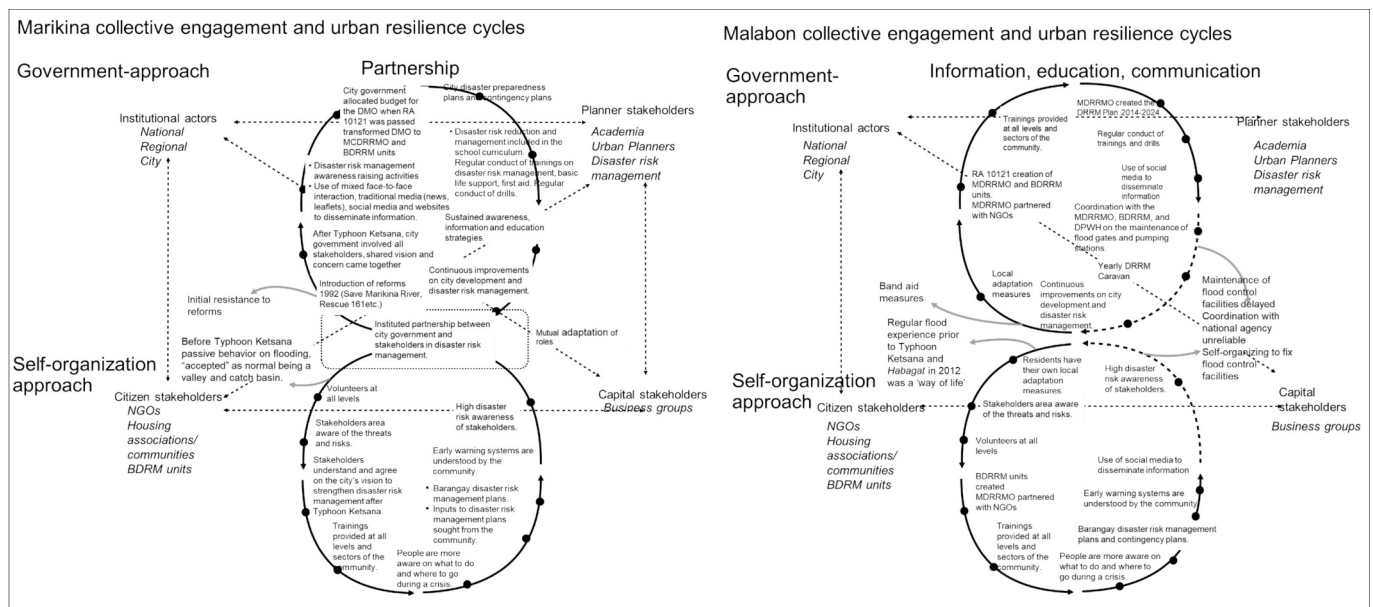


Fig. 7. Summary of Marikina and Malabon's process of collective engagement and urban resilience.

city government encouraged interactions and collaborations by involving the community in decision-making, planning, and project implementation. This strategy assists non-state stakeholders in understanding the risks and vulnerabilities in their cities, making them more willing to collaborate in the city's objectives.

In this research I found that the city's institutional capital is crucial for collective engagement and urban resilience. Economic and environmental capitals provide resources and capacity to address flood hazards, influencing urban resilience financially and physically. However, the institutional (local government) strength and commitment to adopt national level policies, specifically customize them at the local level, and implement them became the foundation of their development. Social networks, raising awareness through information, education and communication directly link collective engagement and urban resilience, all of which are indicators of social and human capitals.

Collective engagement in the city cases showed that through the influence of information, social networks, and mutual adaptation of stakeholders' roles the cities can build urban resilience. These elements are present in the three drivers of resilience: institutional, social, and human capitals. As such even if cities have a lower degree of adaptive capacity but a high degree of collective engagement, cities can still reach a satisfactory level of urban resilience. This implies that stronger drivers of resilience compensate for weaker drivers inevitably contributing to a degree of urban resilience. However, this also shows that the stronger resilience driver becomes the focal point of the city's urban resilience, such as engineering resilience in the case of Rotterdam, and community resilience in the case of Malabon.

Finally, the cases demonstrate that collective engagement and urban resilience is a continuous, complex, and dynamic process. The patterns over time in the cases show that actions taken vary in strategies and periods. It indicates that learnings extracted from past experiences whether effective or ineffective are adjusted to suit the present circumstances demonstrating the capacity of the cities to adapt, learn, and transform which is the nature of urban resilience.

6. Conclusions

Instead of just looking into the structural aspects of addressing disasters and urban resilience I looked into the different stakeholders involved in urban planning and disaster risk management and the enabling factors that facilitate these initiatives. In this manner, the

research contributed to the discussion on cross-sector collaboration between stakeholders that is found to be a means to solve wicked problems and achieve common goals (Ansell & Gash, 2008; Bryson et al., 2006; Simo & Bies, 2007). Through analyzing each of the case cities' adaptive cycles, how it was triggered by a disturbance (flood disaster, ravages of war, reforms), what policies were developed, how cities adopted these policies, and why (and why not) stakeholders collectively engage, the research found not just the networking and collaborative aspect but also how institutional systems are anchored on discursive systems, and how risk and resilience are found to be social constructs.

It showed that collective engagement contributes to urban resilience depending on the type, amount, frequency, and reach of information and education on disaster risk management, strength of social networks, and mutual understanding and adaptation of roles of both state and non-state stakeholders in resilience building. The availability and accessibility of disaster risk management information and education, as well as consistent communication and engagement, are critical for developing an informed and risk-aware community while also promoting social cohesion. Social networks are important in urban resilience at all stages of disaster risk management, especially in the preparatory, response, and recovery stages.

The CEUR framework illustrates a transformative perspective to disaster risk management and urban resilience by emphasizing two procedural approaches (government and self-organization) to building urban resilience. Most resilience studies stress vertical and horizontal links, generating feedback mechanisms in decision-making among stakeholders that contribute to effective governance systems and resilience development (Baud & Hordijk, 2009; Gotham & Campanella, 2011; Sharifi & Yamagata, 2016). However, in this research, the two approaches not only show the vertical and horizontal linkages but that creating urban resilience requires a networked management approach rather than a top-down or bottom-up approach. Network management in governance networks are "more or less stable patterns of social relations between mutually dependent actors" (Klijn & Koppenjan, 2015: 11) that attempt to handle policy challenges through a series of interactions. The outcomes of these interactions, and the number and types of stakeholders engaged, must also be considered. Despite this, it should be noted that the size of the networks or the number of stakeholders involved in the collaborative process does not equate to its legitimacy or deliberative participation; rather, it is the quality of the collaborative process (Huck et al., 2021; Mosley & Wong, 2021);

Sotarauta, 2001; Van Meerkerk & Edelenbos, 2014; Ysa et al., 2014). Further, the drivers of resilience and indicators used in this research mainly provide an indication of adaptive capacity. To assess the usefulness of this framework, a comprehensive set of indicators should be identified and statistically examined, such as Cutter et al.'s (2010) baseline resilience indicators for communities.

As evidenced by the cases, the governance and self-organization approaches to promoting urban resilience through collective engagement work best when implemented in parallel. This does not necessarily imply that these two approaches are collaborating on a single project or program, though they may be (for example, co-production in Dordrecht in developing floating houses and collaboration on the Room for the River), but rather that these two approaches are aligned towards the same vision (i.e. partnership between Marikina city government and residents). Huck et al. (2021) concluded that local activities should be connected with regional and national levels of government, and the duties and responsibilities of cross-sector and cross-departmental groups should be defined. As such, while striving to institutionalize urban resilience, stakeholders' mutual adaptation of roles is critical in the process of collective engagement and improving the adaptive capacities of stakeholders and sectors involved in the urban environment.

Finally, this research makes a critical practical contribution by recognizing that urban resilience may be viewed from multiple perspectives, and the only way to gain a more widespread knowledge of urban resilience is to engage in discourse with and among stakeholders. While this research provides a general concept that encompasses qualities and prerequisites for urban resilience, policymakers must be able to integrate these concepts into the city's social and cultural context. The

sense of place and being of stakeholders in a city must be considered in urban development and resilience building because this connection between stakeholders and the city can assist in the process of collective engagement. To do this, institutional actors must take the lead in building an enabling environment that stimulates participation and interaction among stakeholders, allowing them to develop a shared vision and concept of urban resilience. This allows stakeholders to fully understand resilience and, as a result, engage and deliberate more effectively.

CRedit authorship contribution statement

Theresa Audrey O. Esteban: Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

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

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Appendix A. Criteria, variables and indicators for assessing a resilient city from Esteban (2022) systematic literature review

Criteria for assessing a resilient city	Variables	Indicators	Key sources
Adaptive capacity and resilience to manage, adjust, learn and cope with different changes	Develop alternative scenarios	Shared vision among stakeholders that reflect social needs and the existing diversity of values Stakeholders are motivated to contribute to achieve the vision Wide range of urban strategies, programs and projects Flexible range of urban strategies, programs and projects Urban development scenarios mutually shaped by social, ecological, economic and technological dimensions Stakeholders choose alternative scenario and understand uncertainties Scenarios and options for action including preconditions and implications for relevant stakeholders	Wolfram (2016)
	Different types of knowledge for learning on adapting to changes and uncertainty	Technological knowledge Experiential knowledge Social learning Use of local and community-based knowledge Transformational knowledge Systematic management of practical knowledge to implement sustainable development projects and programs Collaborative learning	Wilkinson (2012); Gotham and Campanella (2011); Steiner (2014); Wolfram (2016)
	Capacity of the community to cope with past and future threats	The community coped with the disaster event at the time The community has learnt from past disaster experiences and can now cope better in the future Reduced threats from disasters through individual and collective action Improved livelihoods through individual and collective action Identification of issues related to natural resources management and sustainable livelihood and industries.	Schwarz et al. (2011); Steiner (2014); Djalante and Thomalla (2010); Bhattacharya-Mis and Lamond (2014); Sharifi and Yamagata (2016)

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Criteria for assessing a resilient city	Variables	Indicators	Key sources
	Adaptive co-management and cross-scale interactions	<p>Application of what was learned from the disaster in future planning and design</p> <p>Capacity to avoid, reduce, minimize impacts of disaster</p> <p>Ability to learn to mitigate future disasters</p> <p>Understanding and awareness of the uncertainty of risk plays an important role in building up of adaptive capacity within the system</p> <p>Appropriate capacity to understand status-quo, and identify patterns, potential threats, and contingencies</p> <p>Multi-level collaboration: between stakeholders and government; between stakeholders and private institutions and organizations; between stakeholders, the private institutions and organizations, and the government</p> <p>Stakeholders provide feedback on government services</p> <p>Knowledge sharing and integration</p> <p>Trust building</p> <p>Government and stakeholders monitor and adapt co-managed projects and programs</p> <p>Presence of leaders and agents for change</p> <p>Linked social, technical and institutional networks</p> <p>Functional relationships between systems and networks (receive support, provide inputs and feedbacks)</p> <p>The managerial capacity to effectively coordinate preparatory and recovery actions between various sectors and organizations at different scales.</p> <p>Physical relationships between systems and networks</p> <p>Flexible systems able to respond to disturbances and changes</p> <p>Focus on localization of social and economic processes and activities</p> <p>Encourage multi-stakeholder participation and engagement in disaster risk reduction activities</p>	<p>Wilkinson (2012); Gotham and Campanella (2011); Wagner et al. (2014); Sharifi and Yamagata (2016); Mehmood (2015)</p>
	Integrated and strong governance structure	<p>Multi-level capacity development: public, private, civil society sectors at the individual, household, organizational levels</p> <p>Interactions between political-administrative levels and between geographical scales</p> <p>Ensure all stakeholders have access to resources and services</p>	<p>Djalante and Thomalla (2010); >Pickett et al. (2013); Romero-Lankao and Gnatz (2013); Wolfram (2016); Sharifi and Yamagata (2016)</p>
	Capacity to adapt to external changes	<p>Ability to survive and cope with disaster with minimum impact and damage</p> <p>Complementary functions between geographically proximate places</p> <p>Understand that cities are complex systems that change is a long term social and political condition and process following a disturbance</p> <p>Ability to conduct rebuilding work</p> <p>Ability to recover quickly and effectively</p> <p>Renewal, innovation, recombination, self-organization and novelty following stress conditions</p> <p>Adaptation to external changes while balancing ecosystem, economic and cultural functions</p> <p>Ability to adjust to actual or expected changes and consequences</p>	<p>Chelleri et al. (2015); Djalante and Thomalla (2010); Bhattacharya-Mis and Lamond (2014); McSweeney and Coomes (2011); Wolfram (2016); Hooli (2016); Mehmood (2015); Takeuchi et al. (2014)</p>
	Self-organization	<p>Multi-scale networks and connectivity</p> <p>Interplay between diversity and disturbance</p> <p>Community-based management</p> <p>Strong local communities capable of independently responding to disasters.</p> <p>Stakeholders involved in cross-scale partnerships</p> <p>Strong horizontal and vertical institutional connections that provide direct feedback to the system and enable better informed decision-making</p> <p>Presence of strong leadership that facilitates the ability to set goals and visions, and initiate actions.</p> <p>Stakeholders from all sectors of society have a strong sense of social and environmental citizenship</p> <p>Stakeholders support locally driven initiatives</p>	<p>Wilkinson (2012); Hooli (2016); Sharifi and Yamagata (2016)</p>
	Transformability and innovation	<p>Spatial heterogeneity</p> <p>Continuous and stable adaptation through rising productivity and innovation over time.</p>	<p>Seeliger and Turok (2013); Steiner (2014); Mehmood (2015); Takeuchi et al. (2014); Sharifi and Yamagata (2016); Wolfram (2016)</p>

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Criteria for assessing a resilient city	Variables	Indicators	Key sources			
Disaster preparedness, risk perception and awareness and recognition of disaster impacts at different levels and scales	Recognition of risks and hazards, and their potential impacts at different scale levels	Improved social relations between stakeholders, public and private institutions Empowering the people in terms of socio-political decision-making and satisfying basic human needs Enable high level of innovations in both technical, structural adaptation measures and social, economic, non-structural measures Utilizing innovations in management, planning, and designing the urban system Ability of the urban system to adjust to external and internal change through self-organizing and collective learning	Baud and Hordijk (2009); Ainuddin and Routray (2012); Mehmood (2015)			
		Ability to adjust, adapt and progress to a new regime Access to creativity and innovation occurring in other cities and nations Ability to adapt and cope with constant change Contribute to building alliances and networks to produce projects of wider societal benefits Recognize and develop local risk profiles Develop knowledge on hazards and risks Capacity of institutional networks to deal with potential and existing risks Know and allocate or access funding flows for dealing with risks Proactive identification of risks and hazards Flexibility and adaptability in both physical as well as social network systems Use of knowledge and information Experience in working together with different actors Political leadership Awareness and understanding of disasters and how to cope with it Awareness and understanding of preventive mechanisms				
		Ability to cope with risks and hazards		Available funding from local government, public, and/or private organizations Strength of social capital in civil society organizations (learning, self-organizing capacity) Linkages to all levels of the government National government provides organized support for local governments National networks of civil society organizations	Baud and Hordijk (2009)	
		Long-term planning		Links with international disaster relief organizations Local capacity in disaster planning Disaster prevention planning are in place Adaptation planning are in place Support programmes for rebuilding and adaptation Financial support for rebuilding		Baud and Hordijk (2009)
		Established enabling or supporting environments in creating a resilient city		Bridging connections to create opportunities of learning and cooperations	Social networks and links (number of social networks and links) Sharing of information, knowledge, and resources (types of information sharing and knowledge disseminated; types of resources available; increase disaster awareness and protection through social learning and connections) Mobilization of neighborhood coalitions (number and type of neighborhood coalitions) Nonprofit organizations and cultural associations (number and type of nonprofit organizations and associations) Trust and cooperation Awareness building Public education and outreach Consensus building (understanding actor networks and their influence on discourse) Convening diverse urban actors to lead shared learning Work together with local community networks Provision of space for ideas and participation of different actors and stakeholders Flexible patterns of planning and management Emphasis on the strength of horizontal and vertical networks Community empowerment and autonomy	

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Criteria for assessing a resilient city	Variables	Indicators	Key sources
	Built- and natural- capital	<p>Rapid mobilization of resources for a timely recovery upon a disturbance</p> <p>Participation in community level programs to increase collaboration capacities with communities and strengthen social capital and adaptive capacity</p> <p>Powerful institutional mechanisms</p> <p>Abundant resources</p> <p>Intact natural resources structure</p> <p>Natural resources sourced sustainably</p> <p>Improved physical accessibility</p> <p>Promote affordable and sustainable economic options that build on an social capital and ecological capital</p> <p>Physical order of urban area</p> <p>Available climate and disaster proof infrastructures</p> <p>Development of physical structures or engineering techniques to reduce or avoid disaster impacts</p> <p>Resources and supporting processes must be supplied by ecosystems beyond any formal urban borders</p> <p>Includes both built and designed elements and natural features</p> <p>Expand the limits and reduce the threats posed by nature</p>	<p>>Pickett et al. (2013); Mehmood (2015); Sharifi and Yamagata (2016); Djalante and Thomalla (2010); Romero-Lankao and Gnatz (2013)</p>
	Engineering/technical solutions	<p>Land use, urban geometry and morphology</p> <p>Long-term structural transformation (transitions)</p> <p>Support for the use of green infrastructure (environmental conditions; social relations; economic incentives and constraints; political and regulatory systems)</p>	<p>Bahadur and Tanner (2014); Chelleri et al. (2015); Steiner (2014); Sharifi and Yamagata (2016)</p>
	Interdisciplinary approach to address planning challenges	<p>Inclusive and multidisciplinary notion of progressive dimension with a strong social dimension especially focusing on the disadvantaged and vulnerable groups and communities in a city.</p> <p>Improved social, economic and environmental well-being</p> <p>Development of innovative technologies</p> <p>Develop knowledge and information based on culture, organized structures, and practical application of adaptive measures</p> <p>Analysis of conflicts between governance structures, institutions and stakeholders</p> <p>Stakeholders recognize different degrees of changes (e.g. concerning institutions, regulations, infrastructures, built environs, routines, values)</p> <p>Both technical and non-technical stakeholders are involved in knowledge production</p> <p>Stakeholder organizations support transformative actions</p> <p>Stakeholders provide critical assessments of adaptive actions</p> <p>Stakeholders (citizens, civil society organizations, public and private sector) participate directly in the deliberation of actions with the government</p> <p>Government recognize the role of stakeholders and help build social capital</p> <p>Build institutional capital through mobilization and support</p> <p>Government recognize the importance of multi-level and cross scale interactions</p> <p>Number of ties between stakeholders involved with common interest and balance socio-ecological perspectives</p> <p>Key individuals leading knowledge and information exchange between sectors and levels</p> <p>Established communities of practice to help articulate societal needs</p>	<p>Pickett et al. (2013); Mehmood (2015); Sharifi and Yamagata (2016); Wolfram (2016)</p>
	Institutional and governance conditions	<p>Gaps in social services and resources are identified</p> <p>Adapt institutional, legal and policy change to include adaptive capacity to build resilient cities</p> <p>Opportunities for leadership</p> <p>Developing human skills within community</p> <p>Disaster risk reduction integrated in government investments and priorities</p> <p>Employ more bottom-up management and decision-making</p>	<p>Gotham and Campanella (2011); Sharifi and Yamagata (2016); Bahadur and Tanner (2014); Steiner (2014); Djalante and Thomalla (2010); Pickett et al. (2013); McSweeney and Coomes (2011); Schwarz et al. (2011); Ainuddin and Routray (2012); Wolfram (2016); Chelleri et al. (2015); Takeuchi et al. (2014); Wagner et al. (2014); Sharifi and Yamagata (2016)</p>

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Criteria for assessing a resilient city	Variables	Indicators	Key sources
		<p>Develop more holistic approaches to top-down decision-making</p> <p>Favor solutions that rely on decentralized infrastructures</p> <p>Generate incentives in building resilient cities and infrastructures</p> <p>Connections or association of city functions with peoples shared values and desires</p> <p>Enact new, locally meaningful post-disaster order</p> <p>Designated leaders within a decision making hierarchy</p> <p>Organizational and institutional capacities</p> <p>Governance performance and rights</p> <p>Access to markets and financial services</p> <p>Strong leadership by local customary authority</p> <p>Transparent and participatory governance would also facilitate learning from past events and “learning by doing” that are essential for boosting the adaptive capacity of the system.</p> <p>Implementation of building codes</p> <p>Regulations are aligned with the vision and adjusted to remove innovation barriers and support transformative actions</p> <p>Regulations leave room for alternative solutions and context-specific interpretation and implementation.</p> <p>Regulations enable to use wider resource streams for transformative action (financial, human, technical, organizational)</p> <p>Spatial stretching of policy decisions</p> <p>Social capital</p> <p>Long-term cultural commitment</p> <p>Build overlap in governance</p> <p>Creating opportunity for self-organization</p> <p>Broad community involvement, trust and motivation</p> <p>Involvement of many stakeholders (from local municipalities, the private sector, non-profit and non-governmental organizations)</p> <p>Influence of institutions in shaping adaptive capacity of society</p> <p>Local patterns of reciprocity and exchange</p> <p>Capability of sensing threats</p> <p>Ability to detect disturbances and be able to make prompt changes and adjustments</p>	
	Social development (social resilience)	<p>Emergency management</p> <p>Social and administrative services</p> <p>Social-economic and political linkages</p> <p>Integration of development efforts across sectors such as government, economic, social and the built environment</p> <p>Increase local/community capacities (institutions and mechanisms)</p> <p>Build trust, values, partnerships, networks and capacity</p> <p>Involvement of community in the design and implementation of activities</p> <p>Application of knowledge, practice, and agreement to reduce risks and their translation into laws, codes and policies</p> <p>Civic dialogues and suggesting processes of change towards that goal</p> <p>Promotion of social equity</p> <p>Includes the interaction of human decisions and ecological processes</p> <p>Behavioural change to transition to becoming resilient communities and eventually cities</p>	Djalante and Thomalla (2010); Pickett et al. (2013); Sharifi and Yamagata (2016)
	Economic development	<p>Community self-reliance</p> <p>Diversity of livelihoods sources</p> <p>Economic strength</p> <p>Provision of capitals that influence peoples livelihoods</p> <p>System 's capacity to mobilize the resources necessary for recovery and return to normal functioning within an acceptable time frame</p>	Djalante and Thomalla (2010); Sharifi and Yamagata (2016)
	Nurture conditions for recovery and renewal after disturbance	<p>Social capital</p> <p>Network of actors</p>	Wilkinson (2012); Romero-Lankao and Gnatz (2013)

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Criteria for assessing a resilient city	Variables	Indicators	Key sources	
Maintaining city resilience through diversity		Cities form a continuum with nature through interactions between societal and ecological processes.	Gunderson (2010); Wilkinson (2012); Ainuddin and Routray (2012); Takeuchi et al. (2014)	
		Introduced innovative responses to their own particular set of pressures, constraints and opportunities		
		Broader and more stable level made of economic developments, political coalitions, environmental problems (e.g. climate change)		
		Stable social, ecological, technological development trajectories		
		Physical, human, cultural and material hybrids embedded in the social construction and transformation of ecosystems' structure, function and services		
		Economic activities		Number and type of economic activities
				Number of employed residents by industry type
				Socio-economic diversity
				Income/economic related
				Diversified sources of income
Natural capital		Number and types natural resources	Gunderson (2010); Pickett et al. (2013); Takeuchi et al. (2014); Schwarz et al. (2011); Wilkinson (2012); Chelleri et al. (2015); Romero-Lankao and Gnatz (2013); Sharifi and Yamagata (2016)	
		Regulatory feedbacks on populations		
		Regulated natural resources		
		Increase biodiversity		
		Ecological diversity		
		Diverse in terms of land use patterns, infrastructure, supply providers, knowledge economy, and demographic structure.		
		Social capital		Formal and informal social networks
				Number and type of social networks present
				Number and type of formal social networks
				Number and type of informal social networks
Social resilience		Percentage of population part of formal networks	Gunderson (2010); Wilkinson (2012); Takeuchi et al. (2014); Schwarz et al. (2011); Wolfram (2016)	
		Location of formal networks vis-a-vis percent of population part of formal networks		
		Type of community activities		
		Number of community activities		
		Trust and communication		
		Flow of resources and ideas that facilitate connections among people		
		Facilitate socio-economic diversity		
		General demographic characteristics of households		
		Number of households		
		Number of population		
Memory based disaster experience	Memory pathways	Number of ethnic group, age, etc.	Bhattacharya-Mis and Lamond (2014); Wilkinson (2012)	
		Diverse stakeholders from across sectors and levels are involved in the co-production of knowledge on urban development		
		Socio-ecological diversity		
		Sparking human ingenuity, technology and collective determination to intervene and avert looming disaster		
		Available resources		
		Locational choice		
		Strengthened regional and community resilience		
		Strengthening local traditions		
		Providing opportunities for all ages to participate in the creation of strategies		
		Engaging communities in restoration activities and through environmental education and education for sustainable development implementers of plans for the park in collaboration with sustainability scientists have the opportunity to develop a model for restoration of social ecological systems		
Strength of the system to withstand short-term (sudden), acute internal and external shocks without suffering from major degradation of the main functions				
Memories passed on through individuals within the family over generations	Bhattacharya-Mis and Lamond (2014); Wilkinson (2012)			
People with long term residency in a disaster affected area often refer to their childhood memories and try to relate them with changing attitude towards living with risk				
Community interactions				

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Criteria for assessing a resilient city	Variables	Indicators	Key sources
Social, physical and economic drivers that contribute to household, community, and city resilience	Memories of social and external support	Information of physical locations previously flooded can be gained from lay knowledge of flooded individuals Resistance or resilience measures adopted by flood affected populations Readiness to discuss the experience Building memory from the past and using previous experiences in the coping process to face anticipatory disturbances in the future Positive memories on social support during stressful time Reduce pressure level and stabilize the post disaster situation especially for the well-being of more vulnerable section of the population Local institutions as support system for the community Ability and capacity of community or individual to respond or recover from the disaster rather than depend on external assistance or aid Governance and institutions Institutional with mandates and knowledge to implement climate adaptation	Bhattacharya-Mis and Lamond (2014); Hooli (2016); Wagner et al. (2014)
	Human and social capitals	Age Life stage Prior health (physical and mental) Social demographics Living condition and setting Income	Bhattacharya-Mis and Lamond (2014)
	Predictive capacity	Past experience or history of natural disasters Capacity to foresee impacts of natural disasters Anticipating impact of disasters Human capacity for foresight and intentionality Ability to foresee and strategize actions	Gunderson (2010); Wilkinson (2012)
	Learning from disaster experience	Creation of new policies or approaches to solve problems that were revealed by an ecological event Stakeholders collectively participate and take action to become resilient Ability to solve a problem or reach another regime Assume change and uncertainty Development of informal, creative, and sustainable solutions to infrastructure provision	Gunderson (2010); Wilkinson (2012); Steiner (2014)
	Economic capital	Economic condition and financial capacity High economic growth Diversified income Insurance Coordination, cooperation with other sectors Stable macroeconomic setting Stakeholders are provided access to resources (human, knowledge, financial, technical, etc.) for capacity development Slow social, economic, and political transformation towards sustainability	Ainuddin and Routray (2012); Schwarz et al. (2011); Wolfram (2016); Chelleri et al. (2015); Romero-Lankao and Gnatz (2013); Takeuchi et al. (2014); Sharifi and Yamagata (2016)
	Social and human capitals	Demographics Build social capital to address equity Ability to foresee and plan for uncertainty and nonlinearity of the impacts and behaviors upon a disturbance Self-reliance that gives the ability to maintain a minimum acceptable level of functioning (without external support) when influenced by disturbance. Increasing social and ecological diversity Ability to deal with information Information networks that work Ability to cope with contingencies Level of social cohesion and governance Human capability Assets and income poverty Age Education Capacity to diversify income Increasing connectedness Increased learning capacity of communities through knowledge exchange and sharing mutual experiences	Pickett et al. (2013); Schwarz et al. (2011); Mehmood (2015); Ainuddin and Routray (2012); Gotham and Campanella (2011); Wolfram (2016); Sharifi and Yamagata (2016); Bahadur and Tanner (2014); Hooli (2016); Djalante and Thomalla (2010); Chelleri et al. (2015); Romero-Lankao and Gnatz (2013); Takeuchi et al. (2014)

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Criteria for assessing a resilient city	Variables	Indicators	Key sources
		Using locally available social, human, cultural and environmental resources Expansion of networks and strengthening the sense of community through building social, cultural and human capitals Institutional capacity, social and political makeup Education Population growth Community competency Household characteristics Socially vulnerable groups Humans as agents of change acting within social-ecological systems Culture Personal behavior Social organization Economic status Self-organization Social characteristics Living conditions Assets and livelihood strategies Practical approaches for coalition building and decision-making Citizens agree to participate and change their behavior Understanding that behavior change takes time and depends on the strength of social capital Community mobilization, participation, and awareness Community knowledge Community dialogue and meetings Shared vision and collective decision on future pathways Formation of cohesive relationships and identity Community partnerships and participation Adaptive capacity and resilience to manage, adjust, learn and cope with different changes Capability to draw up internal resources and competencies to management demands, challenges, and changes encountered in the course of a disaster Social construction and transformation of physical and climatic conditions (the environment) Adopts diverse mechanisms to live and learn from the change and shocks Present natural hazards and adaptation or mitigation measures In-stock natural resources Physical environment Distance to evacuation site Location Open spaces House type with construction materials used Climate change and environmental uncertainty Meeting land use changes and population pressure Infrastructure development Biodiversity Nurturing biological and cultural diversity Practical approaches for coalition building and decision-making Citizens agree to participate and change their behavior Understanding that behavior change takes time and depends on the strength of social capital Community mobilization, participation, and awareness Community knowledge Community dialogue and meetings Shared vision and collective decision on future pathways Formation of cohesive relationships and identity Community partnerships and participation Adaptive capacity and resilience to manage, adjust, learn and cope with different changes	Ainuddin and Routray (2012); Schwarz et al. (2011); Chelleri et al. (2015); Romero-Lankao and Gnatz (2013); Takeuchi et al. (2014); Sharifi and Yamagata (2016)
	Natural and physical capital		

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Criteria for assessing a resilient city	Variables	Indicators	Key sources
	Natural and physical capital	Capability to draw up internal resources and competencies to management demands, challenges, and changes encountered in the course of a disaster Social construction and transformation of physical and climatic conditions (the environment) Adopts diverse mechanisms to live and learn from the change and shocks Present natural hazards and adaptation or mitigation measures In-stock natural resources Physical environment Distance to evacuation site Location Open spaces House type with construction materials used Climate change and environmental uncertainty Meeting land use changes and population pressure Infrastructure development Biodiversity Nurturing biological and cultural diversity Open spaces House type with construction materials used Climate change and environmental uncertainty Meeting land use changes and population pressure Infrastructure development Biodiversity Nurturing biological and cultural diversity	Ainuddin and Routray (2012); Schwarz et al. (2011); Chelleri et al. (2015); Romero-Lankao and Gnatz (2013); Takeuchi et al. (2014); Sharifi and Yamagata (2016)

Appendix B. Drivers of resilience and indicators (Esteban, 2022)

Drivers of resilience	Indicators	Sources
Human capital	Memory-based disaster experience Demographic profile - age, life stage, population, education	Bhattacharya-Mis and Lamond (2014); Wilkinson (2012); Pickett et al. (2013); Schwarz et al. (2011); Mehmood (2015); Ainuddin and Routray (2012); Gotham and Campanella (2011); Wolfram (2016); Sharifi and Yamagata (2016); Bahadur and Tanner (2014); Hooli (2016); Djalante and Thomalla (2010); Chelleri et al. (2015); Romero-Lankao and Gnatz (2013); Takeuchi et al. (2014); OECD, 2016
Social capital	Social networks Community coalitions	Bhattacharya-Mis and Lamond (2014); McSweeney and Coomes (2011); Wolfram (2016); Wilkinson (2012); Hooli (2016); Sharifi and Yamagata (2016); >Pickett et al. (2013); Schwarz et al. (2011); Mehmood (2015); Ainuddin and Routray (2012); Gotham and Campanella (2011); Wolfram (2016); Sharifi and Yamagata (2016); Bahadur and Tanner (2014); Hooli (2016); Djalante and Thomalla (2010); Chelleri et al. (2015); Romero-Lankao and Gnatz (2013); Takeuchi et al. (2014); OECD, 2016
Institutional capital	Existence of disaster risk management office Disaster risk management programs and projects Disaster risk management allocated budget and resources	Gotham and Campanella (2011); Sharifi and Yamagata (2016); Bahadur and Tanner (2014); Steiner (2014); Djalante and Thomalla (2010); >Pickett et al. (2013); McSweeney and Coomes (2011); Schwarz et al. (2011); Ainuddin and Routray (2012); Wolfram (2016); Chelleri et al. (2015); Takeuchi et al. (2014); Wagner et al. (2014); Gunderson (2010); Wilkinson (2012); Mehmood (2015); OECD, 2016
Economic capital	Economic diversity Business demography City gross domestic product	Ainuddin and Routray (2012); Schwarz et al. (2011); Wolfram (2016); Chelleri et al. (2015); Romero-Lankao and Gnatz (2013); Takeuchi et al. (2014); Sharifi and Yamagata (2016); OECD, 2016; Djalante and Thomalla (2010); Gunderson (2010); Wilkinson (2012)
Environmental capital	Climate and disaster proof infrastructures Built up areas Available natural resources Open space	Pickett et al. (2013); Mehmood (2015); Sharifi and Yamagata (2016); Djalante and Thomalla (2010); Romero-Lankao and Gnatz (2013); Bahadur and Tanner (2014); Chelleri et al. (2015); Steiner (2014); OECD, 2016

Appendix C. Qualitative scoring

Indicator	Scores	Qualitative scoring description	Mlbn Score	Explanation
Human capital				
Memory-based disaster experience	5	Flood disaster experience translated to preparation and risk awareness.		
	4	Flood disaster experience translated to awareness of risks and vulnerabilities.		
	3	Flood disaster experience translated to some awareness of risks.	3	The level of risk awareness and concern of the people is high. The frequency of floods is considered as part of the culture in Malabon.

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Indicator	Scores	Qualitative scoring description	Mlbn Score	Explanation
Social capital Social capital	2	Flood disaster experience normalized.	5	Malabon works closely with the community, national government agencies particularly the Department of Public Works and Highways and Metro Manila Development Authority. There are also non-government organizations that work with the city and the community.
	1	Flood disaster experience remembered.		
	5	Bonding, bridging and linking ties present from the community to city levels and extends to the regions.		
	4	Bonding, bridging and linking ties present at the city and community levels.		
	3	Bonding, bridging and linking ties present at the community level.		
Institutional capital Policies	2	At most two, bonding, bridging and linking ties present at the community level.	4	When RA 10121 was enacted Malabon created the disaster risk reduction and management office. This was followed by the community based <i>barangay</i> disaster risk management units.
	1	None or weak presence of bonding, bridging and linking.		
	5	Policies from the national government on disaster risk management translated/understood at all levels from national to community level.		
	4	Policies on disaster risk management from the national government translated/understood to policies until the city level.		
	3	Policies on disaster risk management from the national government translated/understood until regional level.		
Economic capital City gross domestic product	2	Policies on disaster risk management partially present.	4	The National Capital Region accounts for 32.3 % of the Philippines gross domestic product. There are 17 cities in NCR which includes Marikina, in 2016 Malabon's income is at P1,133,792,091.89 assuming no significant increase or decrease in the city's income dividing this to NCR's 2019 GDP, Malabon contributes roughly 17.97 % income to NCR. (Philippine Statistics Authority)
	1	Policies on disaster risk management not present.		
	5	The difference of the city GDP to the country GDP is less < 21 in ratio/percentage.		
	4	The difference of the city GDP to the country GDP is 21 < 41 in ratio/percentage.		
	3	The difference of the city GDP to the country GDP is 41 < 61 in ratio/percentage.		
Economic diversity	2	The difference of the city GDP to the country GDP is 61 < 81 in ratio/percentage.	4	Malabon is considered a highly urbanized city in the Philippines. It is home to a variety of industries most prominent are the fish processing factories and plastic manufacturing.
	1	The difference of the city GDP to the country GDP is 81 above in ratio/percentage.		
	5	City meets expected economic diversity.		
	4	City moderately meets expected economic diversity.		
	3	City has an emerging diverse economy.		
Environmental capital Climate and disaster proof infrastructures	2	City has more than one economic source.	3	The CAMANAVA flood control system is located in the city. It has several flood pumping stations.
	1	Single economic source.		
	5	Presence of triple redundant hard preventive infrastructures and climate-adaptive measures.		
	4	Presence of hard preventive infrastructures and climate-adaptive measures that the city utilizes for the benefit of all.		
	3	Presence of hard preventive infrastructures.		
Built up area	2	Presence of climate-adaptive measures only in pocket developments.	1	Malabon has a land area of 15.71 km ² and a population of 365,525. Its population density is at 23,267 inhabitants per square kilometer. (https://www.philAtlas.com/luzon/ncr/malabon.html)
	1	No hard preventive infrastructures or climate-adaptive measures.		
	5	The percent of built-up areas to the total area of the city is 1 < 21.		
	4	The percent of built-up areas to the total area of the city is 21 < 41.		
	3	The percent of built-up areas to the total area of the city is 41 < 61.		
	2	The percent of built-up areas to the total area of the city is 61 < 81.		
	1	The percent of built-up areas to the total area of the city is 81 above.		

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Indicator	Scores	Qualitative scoring description	Mlbn Score	Explanation
Open space	5	The percent of open space to the total area of the city is 81 above.	1	The total built area in Marikina is 13.02 km ² or 83 % of the city's land area. (Marikina City CLUP)
	4	The percent of open space to the total area of the city is 61 < 81.		
	3	The percent of open space to the total area of the city is 41 < 61.		
	2	The percent of open space to the total area of the city is 21 < 41.		
	1	The percent of open space to the total area of the city is 1 < 21.		
Perception of risk and resilience	5	Perception of risk and resilience translates to learning and improving knowledge on disaster risk reduction and management.	3,60	The total open space in Malabon is 0.65 km ² which is 4.12 % of the city's total land area.
	4	Perception of risk and resilience translated to disaster risk reduction and management activities.		
	3	Perception of risk and resilience translated to moderate understanding of disaster risk reduction and management.		
	2	Perception of risk and resilience translated to some understanding of disaster risk reduction and management.		
	1	Limited understanding on risks and resilience.		
Influence of information and education on collective engagement and urban resilience	5	Local knowledge and local adaptation measures combined with knowledge sharing within networks	5	Disaster risk awareness and DRRM activities are disseminated at all levels. Regular trainings and drills provided.
	4	Demonstrable local knowledge and local adaptation measures		
	3	Adequate local knowledge and local adaptation measures		
	2	Some local knowledge and local adaptation measures		
	1	Absence or poor local knowledge on how to address flooding		
Influence of social networks on collective engagement and urban resilience	5	Very high presence of social networks at all levels of stakeholders on DRRM. Engagement at all levels from community to city level.	5	Social networks are present including non-government organizations. Adopt a <i>barangay</i> and adopt a family evacuation strategy.
	4	High presence of social networks at all levels of stakeholders on DRRM. Engagement at all levels from community to city level.		
	3	Moderate presence of social networks at all levels of stakeholders on DRRM. Engagement at all levels from community to city level.		
	2	Presence of social networks on DRRM. Engagement at the community level.		
	1	Low presence of social networks on DRRM.		
Mutual adaptation of roles in disaster risk management	5	Locally organized groups recognized by the government and working with local government.	5	<i>Barangay</i> disaster risk management units are present and prepared. The city government works closely with the BDRRM.
	4	Presence of housing associations, community organizations and volunteers.		
	3	Presence of both housing associations and community organizations		
	2	Presence of organized groups such as housing or community associations.		
	1	No presence or weak presence of organized groups.		
		Total	4,75	

Data availability

Data and related details of the methodology are available in my dissertation in this link: <https://pure.eur.nl/en/publications/collective-engagement-from-disaster-prone-to-disaster-resilient-c>

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