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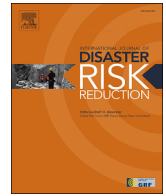
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The politics of urban flood resilience: The case of Malabon city

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ABSTRACT

Policy-making bodies such as the UNISDR have frequently emphasized the role of community resilience in disaster risk management. However, this community-centered approach to enhancing a city's resilience may overlook other critical variables. Few studies have been conducted on the city's process of building urban resilience, as well as the factors that impede or accelerate the resilience process. This article aims to add to the body of literature on urban resilience processes by analyzing the disaster experience and urban resilience of Malabon City, a flood-prone city in Metro Manila's northwestern region. The purpose of this article is to answer the questions, "How does the process of urban resilience occur?", "What factors impede or accelerate the process of urban resilience?" and "Why such factors impede or accelerate the process of urban resilience?" Furthermore, the article adds to the debate about how shifting the responsibility for resilience building to society and the community reduces government and political accountability to the people it is supposed to serve. The article will critically assess the policy environment surrounding the flood infrastructure development in Metro Manila and how it gravely affected Malabon City. The case analysis demonstrates that urban resilience does not follow a linear pattern or a single equilibrium, but rather multiple equilibria of resilience building. It highlights that urban resilience is complex and considers the connections between and among sectors and dimensions within the city. The article indicates resilience as a value-laden and politically charged concept.

1. Introduction

In the past 15 years the term (urban) resilience has become increasingly used in international development and policy-making. Resilience as defined by UNISDR is "the ability of the system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" [1]: 24). This definition is closely linked to community resilience which is the ability of the community to "bounce back" from a disaster [2,3]. It assumes a community centric approach to building resilience which is understandable given the UN's advocacy to empower and enrich stakeholders so that they have the necessary resources and capacity to address potential or immediate disasters.

Community resilience is just one perspective of resilience that is frequently used in disaster risk management work. The engineering resilience perspective, which has been widely accepted for many years, denotes the ability of systems to recover quickly [4]; [5]; [6]; [7]. Moreover, it underlines that resilience is 'coercive', driven by technical rationality [8]. It is also used in disaster risk management to indicate that systems have a single equilibrium, implying that resilience refers to returning the system to its pre-disaster state. This suggests that systems evolve in a linear fashion, a debatable notion, particularly in the study of complex, dynamic systems like

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cities. Other perspectives on resilience, such as ecological resilience and socio-ecological resilience, see resilience as having multiple equilibriums, which means that when faced with a disturbance, systems readjust and learn to adapt and transform to continue functioning. Ecological resilience supports the idea that systems transcend from one state to another following a disturbance [9]; [5]; [6]; [7,10]. Similarly, socio-ecological resilience sees transformation as an essential step in resilience building, and adaptation as an important facet in this transformation from one state to another [11]. While studies on resilience and disasters have clearly defined and identified the types and perspectives on resilience that can be used in many critical studies, there have been few studies on the city's process of building its urban resilience, as well as the factors that impede or accelerate its process.

This article attempts to add to the small body of literature on urban resilience processes by analyzing the disaster experience and urban resilience of Malabon City, a flood-prone city in Metro Manila's northwestern region. We seek to provide answers to the questions, "How does the process of urban resilience take place?", "What factors impede or accelerate the process of urban resilience?" and "Why such factors impede or accelerate the process of urban resilience?" Furthermore, the article contributes to the discussion that shifting the duty for resilience building to society and the community, as many policy documents suggest, reduces government accountability to the people they are supposed to serve. We chose Malabon City as a case study because of its flood history and because it is a city in Metro Manila that has suffered from poor flood infrastructure development. With this case, we seek to demonstrate that urban resilience does not follow a linear pattern or a single equilibrium, but rather multiple equilibria of resilience building. The article is based on the understanding that urban resilience is complex, and it will consider the connections between and among sectors and dimensions within the city.

The article aims to elucidate the city's disaster experience, as well as the various resilience drivers that facilitate (or do not facilitate) the process of building urban resilience. It builds on the conceptual framework outlined by Ref. [11] the collective engagement urban resilience framework (CEURF) which suggests that there are two approaches in building urban resilience, the government approach and self-organization approach. The framework suggests that collective engagement accelerates the process of urban resilience and the mutual adaptation of goals by the two approaches results in sustainability.

We will begin by reviewing critical discourses on resilience in order to better understand why resilience is politically charged and value-laden. This is briefly followed by the introduction of the CEURF to provide context for the conceptual framework and research methodology we used. Next, we present the background for the case study, Malabon City, including national policies implemented by local governments. Here we critically assess the policies and planning direction that transcended for decades that left the city, specifically the community, fending for themselves. Finally, we suggest that politics has a significant impact on urban resilience, and that, contrary to popular opinion, resilience is not value-free.

2. Conceptual starting points

Our conceptual framework of this article starts from a critical perspective to disaster management, climate mitigation and resilience. In policies it is nowadays often stressed that people should "become resilient" to cope with all kinds of (economic, natural and health) disasters and shocks. Anderson (2015: 60) argues that "while there appears to be agreement that resilience has proliferated, there is less consensus about what exactly it is that has proliferated, how and why? (...) In particular, it calls on us to think again about the politics of resilience by making the connections between resilience and specific economic-political apparatuses, including neoliberalism, into a question to be explored rather than a presumption from which analysis begins". In this article we therefore approach the concept of 'resilience' from a critical and political point of view. This critical stance is apparent in the literature on resilience (e.g. Refs. [8,12–18]).

Resilience is often approached from a 'top-down', 'technical' or 'engineering' perspective to resilience are artificial or 'coercive'. Policymakers then rely on this engineering rationality to get things done and recover soon from shocks and bounce back to original states [8]. But there are also alternative approaches to resilience and adaptation, from the bottom-up, often relying on the engagement of local communities. Resilience is highly related to the concept of self-organization and community-based work, organizations and initiatives [19]. Yet, relating resilience to self-organization, and its counterpart self-reliance, in the social, planning, and governance environment, resilience then becomes highly fraught with neoliberal ideological undertones [20]. Within this context, resilience becomes the responsibility of individuals and communities to "pull themselves up by their bootstraps and reinvent themselves in the face of external challenges" [19]: 10). In doing so, this "self-reliance" pressures communities to "bounce back", which may appear to imply that the government should abdicate its responsibilities.

On the other hand, a dominant and top-down approach to implementing (community and urban) resilience is also not favorable, because resilience is built by individuals and communities, not by government and state institutions [21]. "While the existence of engaged social networks help foster adaptive capacity and enhance transformative resilience, it is not a substitute for responsive and accountable governance" (Davoudi et al., 2021: 305). Resilience as a concept is inherently associated with normative-political and moral thinking: resilience for whom, of what to which end, for when, for where and why [14]? These questions are highly political and make resilience a value-laden concept.

We emphasize the importance of resilience as a value-laden concept, because identifying what is good or resilient in a social context is inextricably related to normative judgments. What is widely regarded as a natural or desired benefit may be harmful to others, therefore what is resilient for one person may not be resilient for another. As a result, discussing power and politics in themes like resilience, sustainability, and climate change is unavoidable. There are always power dynamics and arguments regarding what should be accomplished, what type of resilience should be developed, and most significantly, who should be resilient [12,16]. Resilience cannot be discussed in the social, political, institutional realm without considering justice and fairness both in terms of decision-making procedures and the distribution of responsibilities and benefits [12]. This emphasizes the political dimension of resilience that in-

cludes dealing with trade-offs and acknowledging that political context and power dynamics shape resilience policies, with inevitable winners and losers [14].

These conceptual tensions were outlined by Ref. [22] and were used to define urban resilience as “the ability of an urban system and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales-to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity,” [22]: 45). The spatial and temporal urban environment, networks, and adaptive capacity of urban systems are highlighted here. This definition includes the notion that urban systems and their subsystems are made up of diverse networks or diverse sets of stakeholders with varying stakes, beliefs, values, perceptions, and biases [11].

We want to underscore that resilience refers to the ability to adapt and transform, and thus has the adaptive capacity to do so. Esteban [11,23], highlighted that the city's adaptive capacity is what drives it to become resilient, and as such, it is referred to as the drivers of resilience, specifically the city's human, social, institutional, economic, and environmental capitals. These five capitals have been used as the five capitals of sustainability or the five capitals model to show the stock and flows of resources in a sustainable society and economy [24,25]. Esteban [11,23]; used “capital” to refer to these drivers as resources used to produce a desirable good, in this case, urban resilience. This assumes that cities, as complex systems, have the adaptive capacity to absorb disruption, adapt, learn, and transform. When we examine a city's adaptive capacity in this way, we determine whose or what inputs are required to produce the required output (resilience).

2.1. Collective engagement urban resilience framework

With the above conceptual points in mind, we use [11] framework, CEURF, which is based on the idea that cities have five resilience drivers - social, institutional, human, environmental, and economic capitals - which are individual systems that help cities adapt to changes and eventually build resilience. Collective engagement as defined by Esteban [23]: 5; [11], is “[a] collaborative process participated in by multiple stakeholders to arrive at a solution or decision to increase urban resilience through both formal and informal means. It is the collaboration between and among stakeholders over a prolonged period with varying manners in achieving a level of resilience that contributes to a collective goal of urban resilience.” It is a continuous process of engagement with three main elements: “(1) strong information and education on disaster management is provided and accessible to all stakeholders; (2) strong social networks of stakeholders that are collectively involved and tied to the city and its vision to become resilient; and (3) the government and the stakeholders must understand the need to have a cohesive community in order to address disasters” [11,23].

Based on the above the CEURF shows in Fig. 1 that there are two approaches to urban resilience, the government and the self-organization approach. The two approaches can be different but they both go through the same four collective dimensions - collective concern, collective action, collective efficacy and collective security. This implies that the two approaches are concerned with the same issues and have the same vision, and that collaboration between and among government and non-government stakeholders contributes to the development of a shared vision and goal (collective concern). More importantly, despite their difference in approach or strategy, the approaches converge at the same point, indicating similar goals and mutual adaptation of their roles in the process of building urban resilience.

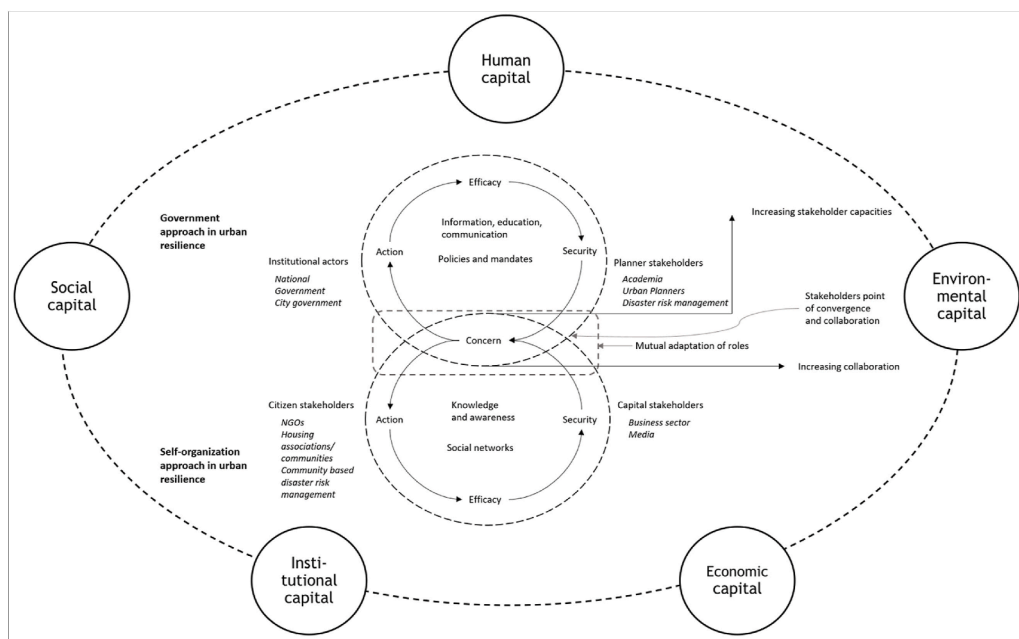


Fig. 1. Collective engagement urban resilience framework. Source [11]:

The stakeholders in the government approach are institutional actors and planners. Institutional actors are those who hold government positions (elected or otherwise) with the legal mandate to plan, develop, and implement city development programs and projects, whereas planners are technical persons knowledgeable on urban management, disaster risk management, who may or may not be involved by the city government, which means they have either a private practice or employed in an organization or institution (i.e. private company, academe, research institution, etc.). The capital and citizen stakeholders are the stakeholders in the self-organization approach. Citizens are housing associations, nongovernmental organizations, community-based disaster risk management units, and community associations/organizations, while capital stakeholders are the business sector and the media.

Collective concern is the first stage, which is normally the concern after a disruption. This is followed by collective action, which is a group effort to address the disruption on an organized level. Collective efficacy refers to creating an environment that encourages co-production, co-operation, and co-creation. Co-production refers to governments and stakeholders working together to deliver public services for the benefit of the entire community [26,27]. Co-operation means being involved in the operation of the initiative regardless of the initiator, designer, or producer, much like a workforce supporting an initiative. Regardless of whether the stakeholders are co-producers, co-creators, or co-operators, the dimension collective efficacy necessitates mutual understanding of each other's roles in building a resilient city. It is the ability to collaborate to co-create a spatial, institutional, and social environment that fosters stability, partnership, and trust. Finally, collective security is the degree to which stakeholders collectively feel safe and secure.

The framework aims to describe the levels of collective engagement and urban resilience that a city has undergone and continues to undergo. In this way, we can understand a city's previous disaster experiences, the approaches that have been implemented, and how the city is moving forward based on these experiences and initiatives. Understanding these aspects of the city's development in terms of urban resilience allows us to facilitate the direction as well as identify and prioritize areas where the city has fallen behind. The CEURF also assists in determining whether city development and disaster risk management activities have a diverse set of stakeholders, as well as whether initiatives are inclusive, understood, and accepted by all stakeholders, rather than just a few. This provides a more comprehensive and focused vision of the city.

The CEURF has been used in other cases, including Rotterdam and Dordrecht in the Netherlands and Marikina City in the Philippines, where different main drivers of resilience were identified for each city [11]. This allows cities to assess their respective adaptive capacities in order to determine which drivers are dominant and which fall short [11]. This can aid in determining which areas of urban development and disaster risk management should be prioritized, as well as which drivers require further strengthening and which can be leveraged. While the CEURF is a useful framework for assessing the resilience drivers, collective engagement, and urban resilience of specific cities, it has limitations. In some cases, cities may lack capital stakeholders who have a direct relationship or interaction with cities in terms of city development, particularly disaster risk management. This reduces the number of stakeholders who can be included in the research and may not provide the overall perspective desired.

Nonetheless, we used this framework to understand the process of building urban resilience in Malabon City, based on the assumption that the adaptation and transformation pathways that the government approach and self-organization approach take are linked with resilience drivers and past experiences. This implies that either the people involved in the government approach and/or the self-organization approach learn from experience and knowledge, or they do not. Furthermore, it implies that other factors may have influenced the city's ability to build urban resilience.

3. Methodology

We adopted an explanatory case study approach to focus on the three main questions “How does the process of urban resilience take place?”, “What factors impede or accelerate the process of urban resilience?”, and “Why such factors impede or accelerate urban resilience?” The case study method is an appropriate research method to understand and examine a phenomenon in its “real-life context especially when [] the boundaries between phenomenon and context are not clearly evident” [28]: 59). It is especially useful when one wants to trace the history and experience of a subject. Doing this gives different impressions of the different circumstances that happened, actors involved and experiences. All together this allows us to give a holistic understanding and analytical generalizations that is important in qualitative research.

We selected Malabon City in the Philippines as the case for this article because it is one of the most flood-prone city in Metro Manila but have only fairly recently been given attention by the national government for flood infrastructure works. We investigated Malabon City's process of urban resilience by discussing the historical disaster experience, as well as national and local policies that influenced city disaster planning. We explored the complex interrelationships between the resilience drivers in relation to disaster experience and planning. Using the CEURF we assessed the city's collective engagement and urban resilience by evaluating: (1) perception of risk and resilience; (2) influence of information and education on collective engagement and urban resilience; (3) influence of social networks on collective engagement and urban resilience; and (4) the mutual adaptation of roles of the government and self-organization approaches.

Data were collected through analysis of policy and planning documents, interviews and focus group discussions of key actors. Key actors interviewed were governance, public policy and planning experts from the academe, local government employees working in the Malabon City Planning Department, Housing and Resettlement Department, City Environment and Natural Resources Office, Disaster Risk Reduction and Management Office, Bureau of Fire Protection, *barangay*¹ council members, and homeowner association members for a total of 16 key actors interviewed. Table 1 below shows stakeholders interviewed per category under the CEURF.

¹ A *barangay* is the smallest government unit, it is also referred to as a village.

Table 1
Malabon stakeholders interviewed.

Stakeholders	Offices/Institutions/Organizations	Total
Institutional Actors	Malabon City Planning Office Housing and Resettlement Department City Environment and Natural Resources Office Malabon Disaster Risk Reduction and Management Office Bureau of Fire Protection	8
Capital	n/a	0
Citizens	Barangay Council Members Homeowners Associations	5
Planners	University of the Philippines Ateneo De Manila University	3
Total		16

The semi-structured interview protocols included open-ended questions and were specifically designed to understand (1) the city's disaster experience; (2) the city's level of collective engagement; and (3) the role of stakeholder participation, awareness, and self-organization in reaching the level of collective engagement. The interview questions are divided into four collective dimensions to elicit collective experiences on the city's transformation process in building urban resilience (see Table 2). The questions are left open-ended to allow interviewees to explain their ideas, perspectives and experiences. Atlas. ti was used to process the interview data.

Data from interviews, focus group discussions, and secondary sources were triangulated, reviewed, and processed. We used a quality of evidence rating [30] to analyze the relationship between the resilience drivers, collective engagement, and urban resilience. The rating has a qualitative score description and is rated as high, medium, or low. Appendices 1 and 2 contain qualitative scoring descriptions for the drivers of resilience, collective engagement, and urban resilience. We used primary and secondary data to assign the scores that correspond to the best description. Two levels of scoring were done, first the drivers of resilience, with the following scoring, high represent the range $4 < 5$ evidence or drivers of resilience show evidence on the city's adaptive capacity, medium represent $2 < 4$ evidence or drivers of resilience show some evidence on the city's adaptive capacity, and low at $0 < 2$ evidence or drivers of resilience show little evidence on the city's adaptive capacity [11]. The second level, collective engagement and urban resilience with the following scoring, high refer to the range $4 < 5$ evidence or collective engagement show evidence on the contribution to urban resilience, medium represent $2 < 4$ evidence or collective engagement show some evidence on the urban resilience, and low at $0 < 2$ evidence or collective engagement show little evidence on the urban resilience [11]. For example, in Malabon, people explained that their disaster experience led them to plan ahead of time and increased their flood disaster awareness, which corresponds to a score of 5 in Appendix 1 under human capital. This provides a current overview of the city based on the research data.

4. Case study setting and introduction

Malabon is located in Metro Manila's northwestern region, surrounded and traversed by twelve rivers, three creeks, and three canals [31]. Since a large portion of Malabon is tidal land, flooding caused by tidal fluctuations occurs on a regular basis. The frequent

Table 2
Collective engagement dimensions vis-a-vis urban resilience.

Dimensions	Description	Urban resilience level	Indicators
Collective concern	Stakeholders remember and learn from past disaster events. Stakeholders translate this experiential knowledge to local adaptation measures and through engaging in networks.	Shared vision and concern in making the city resilient, issues are identified, defined and understood.	- Local adaptation measures - Volunteering
Collective action	Stakeholders are aware of and understand the basics of disaster risk management. The city's willingness to delegate authority and resources to the local level and a working multi-sectoral structure for reducing and managing disaster risk.	Shared understanding and agreement of the issues that the city is facing and the need to find solutions and take action.	- Accessible relevant information on disaster risk reduction and management to all stakeholders. - Citizen led-activities on disaster-risk management.
Collective efficacy	Informed and educated stakeholders on disaster risk management. Disaster preparedness plans and contingency plans are in place. Conduct of regular training and emergency drills.	Increased knowledge and agreement among stakeholders on solutions.	- Disaster risk reduction and management are included in the school curriculum, educational materials and trainings. - Early warning systems are in place for all major hazards in the city. - Regular training and emergency drills are conducted.
Collective security	Mutual adaptation of role of stakeholders in working towards resilience. Behavior change of people towards becoming disaster-risk aware reinforced through continuous IEC.	High disaster risk awareness of stakeholders.	- City-wide information, education and communication strategy exists to increase awareness and stimulate a culture of disaster resilience. - Coordinated disaster risk management across levels.

Source [11,29]:

flooding in Malabon have earned the city the moniker as the “Local Venice.” Malabon residents, who were mostly fisherfolk and fish-pond owners and workers, did not see this as a problem at the time because the water receded quickly. It was not until the city's population began to grow that the city's housing space became constrained. As a fishing village and an important trading hub in Metro Manila, immigrants from nearby cities and municipalities settled in Malabon, putting pressure on the city's housing space. This has resulted in growing urbanization and congestion not just in the spatial make-up of the city but also the outdated drainage system that increased the level of floods which lasted hours if not days.

The succeeding sections will give the main events that transpired in Malabon City beginning with the martial law which happened nationally and greatly impacted the city's development and flooding problem. This is necessary to give an emphasis on how a country's political climate can gravely affect development. Fig. 2 gives the summary dates and events that transpired in relation to flood risk and disaster risk management in Malabon City.

4.1. The martial law period

The Philippine government had planned flood mitigation infrastructures since the 1960s [32], but it took until the martial law period (1972–1981) for these plans to take shape. In 1972, Typhoon Rita (Philippine local name Gloring) plummeted through the Luzon Island of the Philippines leaving Metro Manila and Central Luzon with a total devastation of over 600 dead, 370,547 homeless, and 250,000 ha agricultural damaged [33]: 74; [34,35]. Thereafter, martial law was declared on September 21, 1972 under the premise of the alleged mounting insurgency in the rural areas rather than to address the flood emergency [34,35]. Still, after President Ferdinand Marcos declared martial law, the government formed the Metropolitan Manila Flood Control and Drainage Council under presidential decree 18 [36] to review the previous flood plans and draw up a new flood plan under this period.

In 1975 the Metropolitan Manila Commission (MMC) was established, and these flood plans were formalized [37,38]. Metro Manila had three major flood control projects planned: the Manggahan Floodway, the Napindan Hydraulic Control Structure, and the Parañaque spillway [34,39]. These projects aimed to divert floodwaters from Laguna Lake (Manggahan Floodway and Napindan Hydraulic Control Structure) and water from the lake to Manila Bay (Parañaque spillway) [34]. This focuses flood control efforts in the central, south, and southwest Metro Manila areas, while the rest of the city was supposed to have flood pumps installed along Pasig River tributaries leading to Manila Bay. Given that under martial law, the president assumes total authority and control over the entire government, including its agencies and instrumentalities, as well as the takeover of public utilities, this would have been the ideal time to put these infrastructures in place [40,41]. This means that even without the approval of the legislative branch, the President can direct the planning and construction of public infrastructure, including flood control facilities.

Furthermore, the MMC was established with the mandate of providing services to Metro Manila and acting as a liaison between the national and local governments within Metro Manila and its surrounding municipalities [37,38]), which would aid in expediting necessary public services. President Marcos, on the other hand, appointed his wife Imelda as governor of Metro Manila. Imelda Marcos envisioned a “golden age of infrastructure” as part of the Metro Manila Urban Renewal Project [42–45]. Rather than planning for more public and social services, the plan was skewed toward the construction of “edifice complex” structures, which were built for propaganda purposes [42–45]. Furthermore, with Imelda leading the MMC and her husband leading the country under martial law, projects have gone unchecked for approval by the legislative branch. This resulted in a slew of projects with jacked up prices and kick-backs from World Bank loans [46,47].

In 1974, budget appropriations for public infrastructure were created through Presidential decree 475. This included a budget of PhP199 million for the three main Metro Manila flood control infrastructures [39]. The budget for the Napindan Hydraulic Control Structure increased from PhP85 million to PhP100 million two years later, in 1976, while the budget for the Parañaque Spillway increased from PhP62 million to PhP188 million [48]. Even though the Napindan Hydraulic Control Structure and Manggahan Floodway were completed in 1983 and 1986, respectively, the Parañaque Spillway did not materialize due to financial constraints [32,37,49,50], despite the fact that the budget allocation for the Parañaque Spillway has more than doubled in 1976, according to

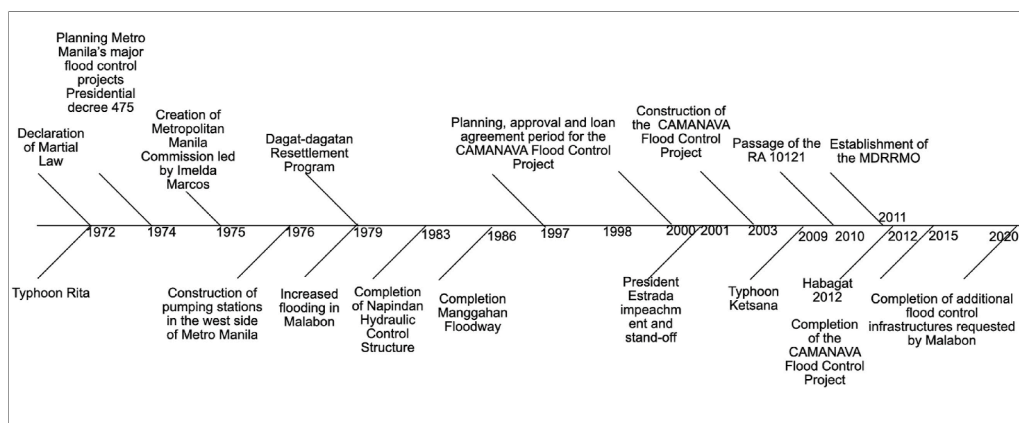


Fig. 2. Summary of dates and flood and political events, mandates, and infrastructure planning. Source: Main author

documents. Furthermore, the total budget for the construction of all three Metro Manila flood control structures, including foreign loans, was PhP962.9 million [37].

4.2. The Dagat-dagatan reclamation and Malabon's worsening flood

One of the projects of MMC as part of Metro Manila's urban renewal plan was the Dagat-dagatan reclamation project. A privately owned fishpond in Dagat-dagatan was expropriated for the purpose of turning it into an area for low-cost social housing. The Dagat-dagatan Resettlement Program in 1979 was aimed to serve not only Malabon City but also Manila's Tondo Foreshore Facility. Slum dwellers and low-income residents in the Tondo Foreshore and Dagat-dagatan areas, as well as the cities of Navotas, Malabon, Caloocan, and Manila, were targeted by the resettlement program [44]. The project not only provided housing units but also job opportunities [51]; however, the reclamation project was deemed a "grand failure" [52] because it was unfinished, and has further clogged the river system, exacerbating the occurrence of flooding in Malabon's already flood-prone area [44,52,53].

The approach towards more "edifice complex" by MMC in its urban renewal plans has resulted in the focus on the aesthetics which neglects essential public infrastructures and appropriate urban planning. The Dagat-dagatan resettlement program is an example of such as this was implemented haphazardly without regard for the consequences for the already flood-prone cities of Malabon and Navotas. Other infrastructures such as the Manila Film Center which ended the lives of allegedly 169 workers when the roof collapsed tragically on November 17, 1981 burying them in drying cement, was also constructed as part of Imelda's capricious demands to rush the completion of the building in three months' time [45].

4.3. The CAMANAVA flood control infrastructure

After the martial law, the Philippines was in great debt that implementation of infrastructure projects had to be reviewed for financial feasibility and government spending had to slow down to keep the economy afloat. The flood control measures were given ample priority given the worsening floods in Metro Manila in particular in the CAMANAVA (Caloocan, Malabon, Navotas, and Valenzuela) region which is located on Metro Manila's northwestern side, adjacent to the Manila Bay. The CAMANAVA Flood Control Project was planned in 1997, more than 20 years after Metro Manila's major flood control projects were conceived. In January 1998, the project was approved for implementation [50]. The project was expected to be implemented soon after, with an initial estimated project run of five years (from 1999 to 2003). As a result, by 1998, Malabon had begun clearing the project areas of informal settlers as part of the CAMANAVA cities' requirements. Flooding in Malabon had already worsened by that point. Floods in the CAMANAVA area increased in height by 0.2–1 m between 1991 and 2002, owing to a combination of sea-level rise, groundwater extraction, and land subsidence [54]. The CAMANAVA Flood Control Project was supposed to be the solution to the region's rising flood levels, but its implementation and completion were delayed.

The first stumbling block was that the loan agreement between the Philippine government and the JBIC was only signed in 2000 [50]. Normally, public bidding for government projects is scheduled immediately following the signing of a loan agreement. However, the project was approved during the Estrada Administration (1998–2001), when then-President Estrada was facing plunder charges and was on trial for impeachment. After a five-day standoff, President Estrada was forced to step-down on January 20, 2001 [55,56]. The Estrada administration was followed by the Arroyo administration (2001–2010), which was also marred by corruption scandals. The CAMANAVA Flood Control Project began bidding in 2002 [50]. The project's implementation began in 2003, pushing the project's completion date and loan agreement to 2007.

Nonetheless, by 2007, the CAMANAVA Flood Control Project was only 88% complete, and the contract with the international contractor, Nishimatsu Corporation Co. Ltd., was terminated in 2008 [50]. The next delay occurred when the remaining work had to be contracted out to another contractor, which required another bidding process. This time the contract was awarded to a group of local contractors, BMW AD Joint Venture and JD Legaspi Construction, until the project conclusion in January 2012 [50,57]. While the project was finally completed in 2012, the Commission on Audit reported subpar construction of the flood control facility that did not completely mitigate flooding in the region, as well as the presence of informal settlers and the volume of waste in the waterways [50]. Malabon government officials and residents were also dissatisfied with the project, [58] which led the city to request for additional infrastructure support. The City of Malabon requested that the Department of Public Works and Highways (DPWH) to raise the polder dike, repair the Catmon Creek and river walls, and construct additional flood gates and pumping stations [59]. These infrastructures were requested to ensure the safety of Malabon residents from flooding, particularly after experiencing heavy floods during Typhoon Ketsana (Philippine local name: Ondoy) in 2009 and *Habagat* (southwest monsoon) in 2012. These DPWH-requested infrastructures were completed in 2015. The DPWH also built two additional pumping stations in 2020 to address the flood problems of six low-lying *barangays* [60].

4.4. The Philippine disaster risk reduction and management act (RA 10121)

In 2010, RA 10121 was passed into law which required the establishment of disaster risk management offices at the local government level, as well as community-based disaster risk management units at the *barangay* level [61]. Malabon responded in 2011 by establishing the Malabon Disaster Risk Reduction and Management Office (MDRRMO). In 2015, the MDRRMO partnered with both local and international non-government organizations (NGOs) such as Action Against Hunger, PLAN International Philippines, CARE Nederland, and Assistance and Cooperation for Community Resilience and Development (ACCORD) to conduct capacity building activities at the *barangay* level. By 2019, through the capacity building activities, each of Malabon's 21 *barangays* were able to establish their own *barangay* disaster risk management (BDRM) units.

5. Case analysis

Fig. 3 illustrates Malabon's adaptive cycles in the CEURF, the figure shows both cycles in the government and self-organization approaches. The timeline depicts the periods when these cycles occurred for each of the two approaches, which started at different points. The figure encapsulates the previous section's discussion that flood infrastructures in Malabon were planned as early as 1970 but were only completed in 2012. Although the flood infrastructure works focusing on the Laguna Lake area (southern Metro Manila) are appropriate because the lake tends to overflow during typhoon and storm seasons, it overlooked the repercussions of the lake's overflow along the Pasig River's tributaries. This lack of foresight and poor planning of the national government, let alone the misappropriation of funds for flood control projects, set back planning for flood control infrastructures in the CAMANAVA region.

As such, Malabon suffered years of neglect that led the city and its residents to take band-aid measures to help reduce flood incidence as also illustrated in the timeline. For a long time, Malabon dealt with floods by pumping floodwater back into the river system using 'bombastics' (water pumps). When the CAMANAVA Flood Control Facility was nearing completion, heavy rains from *Habagat* 2012 caused water to overtop the polder dike [62], flooding 90% of Malabon [63]. As a result of this incident, the polder dike's height had to be increased by 1 m [62]. While the national government dealt with these changes, that same year marked a turning point in Malabon City's approach to flood and disaster risk management.

The magnitude of the flood in 2012 caught the relatively new MDRRMO off guard. The BDRM units in the 21 *barangays* had not yet been established at the time. For rescue and recovery operations, the city had to rely on the assistance of the national government, NGOs (such as the Red Cross), and the private sector and individuals (for donations).

"During the storm Habagat in 2012 ... we were caught unaware. Although ... we had an advisory council, we didn't have a command center. [] It was just us [staff] at the lobby here in the city hall. [] And as much as we wanted to save and make people secure in the evacuation centers we were not ready in terms of equipment." (Institutional actor 2, interview date 15 March 2019)

The 2012 *Habagat* flood experience made the city government realize their lack of disaster planning and preparation, this prompted the MDRRMO to immediately develop their Disaster Risk Reduction Management (DRRM) Plan 2014–2024, as also required by law under RA 10121. The DRRM plan included DRRM capacity-building and awareness-raising activities, the maintenance of a database of DRRM resources such as hospitals and evacuation centers, as well as the location of critical infrastructures, placement of early warning systems, and the organization of local emergency response teams and accredited community volunteers [64].

This became a turning point for Malabon, but it was not without difficulty because people were stubbornly stuck in their old ways of dealing with floods and disasters. A citizen stakeholder interviewed mentioned that "in previous years flood was part of our life. We got used to it," (Citizen stakeholder 3, interview date March 22, 2019). This familiarity with the flood taught people how to prepare during high tide and typhoon seasons by bringing their important belongings one to two floors up and marking their calendars for the high and low tide seasons. However, it was also this familiarity that made them complacent and see the flood incident as a normal occurrence that some people do not evacuate immediately. For an interviewee heavy rains and floods are "*wala na sa amin yun*" (nothing to us) because "*doon kami lumaki*" (that is how we grew up) (Citizen stakeholder 4, interview date March 22, 2019).

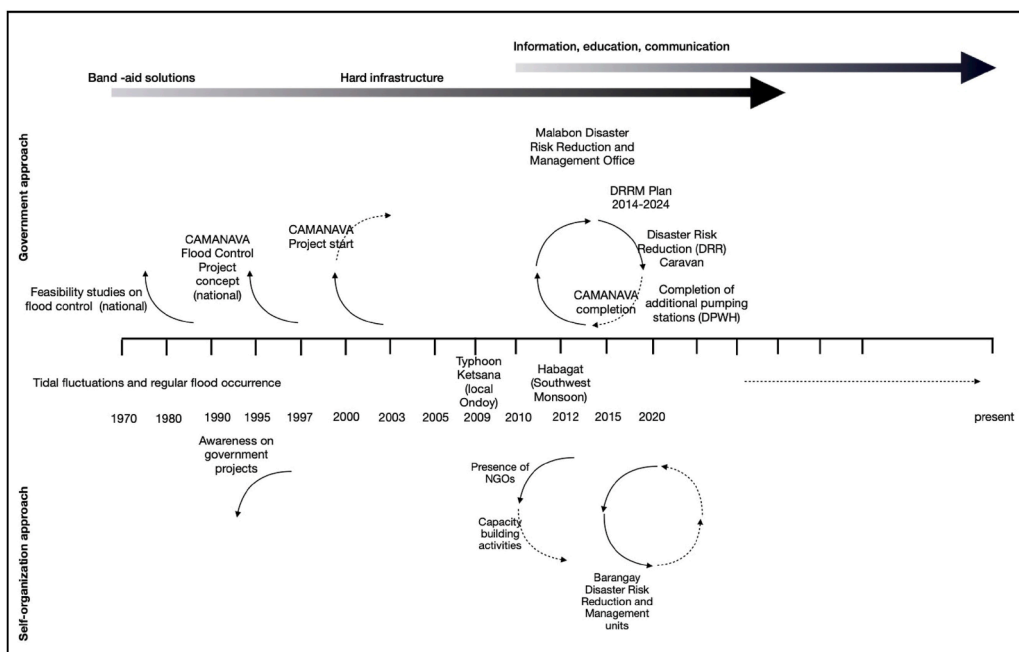


Fig. 3. Malabon's CEURF adaptive cycle transition from hard infrastructure to capacity building in the adaptive cycle. Source [11]:

The MDRMO, aware of their budgetary constraints but also mindful of the need to change the behavior of the people about floods and disasters, partnered with NGOs in 2016 to conduct numerous capacity-building and awareness-raising activities. One such activity done in partnership with Action Against Hunger, PLAN International Philippines, CARE Nederland, and Assistance and Cooperation for Community Resilience and Development (ACCORD) is the Moving Urban Poor Communities towards Resilience (MOVE UP) Project [65]. The project aimed to develop urban resilience and disaster preparedness of the most vulnerable communities in the city by providing sustainable livelihoods and disaster preparedness trainings. The partnerships with the NGOs also gave the *barangays* necessary knowledge on disaster risk reduction and management as well as the initiative to establish their BDRM units.

As shown in Table 3, Malabon's resilience driver is rated medium, with its human, social, and institutional capitals ranking highest. Collective engagement and urban resilience, on the other hand, are rated highly. According to the table, the self-organization approach is more prominent and motivated by its human and social capitals. The city's collaboration with NGOs in their disaster risk management information, education, and communication campaign aided the city in meeting the mandate to establish BDRM units in all 21 *barangays*.

The Malabon City Government strives to carry out their DRRM plan, particularly the DRRM awareness raising activities, knowing that while flood experience makes residents aware of the flood risk, knowledge of DRRM is still required to ensure that residents know what to do in the event of an emergency. As a result, the city hosts an annual disaster caravan, which is supported by government agencies, academic institutions, the private sector, and NGOs. Malabon also makes use of social media in their communication dissemination efforts. The DRRMO and BDRRM units each have their own Facebook pages where they post announcements and important information. The Facebook page's messenger function is also used to communicate with the DRRMO and BDRRM units, as well as to engage with residents via direct messages. This allows stakeholders to engage in direct engagement and communicate more quickly, which is especially important during a disaster where quick communication and reporting is required.

We found that households and community members have been handling the frequent flood incidents on their own, which is a problem, particularly when this is not coordinated with the *barangay* or the city government. One community interviewee shared that because the floodgates are manually controlled, a resident tampered with one of the floodgates in their *barangay* by pounding the floodgate to the ground to prevent water from entering the area. This damaged the floodgate and exacerbated the maintenance issues of the DPWH and the Metro Manila Development Authority (MMDA), which are national and regional government agencies tasked with doing so. The difficulty for Malabon residents, however, is dealing with the DPWH regarding maintenance requests.

“Even if we have flood control facilities, our mechanical pump and electrical pump, most of the time does not work. Maybe because it is always running, it breaks down and it is not that easy to get spare parts from DPWH. That’s where we have difficulties because the flood control facilities are under MMDA and DPWH. The barangay is not in the position to maintain it. If we try to shell out money from the barangay funds it is not that easy to have it reimbursed and we have experienced that, our barangay chairman shelled out Php80,000 to Php100,000. He was not able to have that reimbursed ... the parts were changed but we never got anything back from DPWH. They

Table 3
Qualitative scores of Malabon City's drivers of resilience and collective engagement and urban resilience.

Drivers of resilience					
Human Capital	Social Capital	Institutional Capital	Economic Capital	Environmental Capital	Score
(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 square kilometers 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. ^a	Medium
Collective engagement and urban resilience					
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	Score	
(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 barangay and adopt a family evacuation strategy. Use of social media is high in communicating with the city government.	(high) Barangay disaster risk management units are present and prepared. The city government works closely with the BDRRM.	High	

Notes.

^a Data taken from www.psa.gov.ph.

Source: Derived from [11]

even asked me to bring the equipment which was so heavy and I only had to take the [Metro Rail Transit System] MRT.” (Citizen stakeholder 3, interview date 22 March 2019)

The slow or non-response of the DPWH in providing maintenance service have resulted in the community fixing their own broken down pumping stations to help mitigate floods or, at the very least, lower the height of the flood.

“The pumps’ flooring broke during a typhoon so it was lifted from the ground, water came out from it and flooded the entire area. There was electricity but they cannot turn on the pump because it might get totally damaged. They had to use the mechanical pump. People had to place sand bags on the pumping station just to make sure it will not totally fall apart. The area was immediately flooded.” (Citizen stakeholder 3, interview date 22 March 2019)

These band-aid solutions, which include raising the floors or parking garages of houses higher than the street level for those with more money, and the ‘bombastic’ to help pump floodwater back into the river system, have been in place and practiced for decades. This constant threat of flooding has become ingrained in their culture, which [33] refers to as a “culture of disaster.” As a result, stakeholders have come to associate resilience with survival.

“Resilience is for the people including the government, the community. How they can survive ... It’s about the hazard, how people can easily recover from the hazards and threats in the city. That’s how I see resilience.” (Institutional actor 4, interview date 15 March 2019)

“It is the preparedness and capability to recover from a disaster that you experienced.” (Citizen stakeholder 1, interview date 15 March 2019)

The term “survival” refers not only to their individual survival but also to communal survival. Years of flooding ingrained in their social system provided them with an innate knowledge of community co-dependency, allowing them to collaborate and help one another as a community. *Barangays* that lack evacuation spaces have banded together with *barangays* that have larger evacuation spaces to form “adopt-a-*barangay*,” where *barangays* with no spaces can occupy the evacuation areas of another *barangay*. Some residents with plenty of space, particularly those with rooftops or third floors, have also organized an “adopt-a-family” system in which they open their homes to neighbors in need during a crisis. The residents’ strong human and social capitals assist them in adapting to regular flooding situations.

Human and social capitals are the two critical adaptive capacities on which Malabon has relied for decades in the face of floods. These characteristics are still evident in the way Malabon implements their disaster risk management strategies. Years of flooding have instilled in the residents such a sense of self-preservation and survival that they now take it upon themselves to solve their own flood problems. However, this cannot be attributed solely to the residents; other factors, such as the national government’s inability to meet their needs, have contributed to their desire to be self-sufficient. Malabon’s resilience is centered on their vulnerability to flooding, which was so ingrained in their system that it became a part of their lives. Residents are the living embodiment of ‘community resilience,’ which means they can recover and bounce back using their own resources [2,3].

Malabon has a high level of bonding and bridging relationships, both of which are components of social capital. Bonding relationships refer to a group’s coidentification with a particular cause, issue, or belief [66,67], in this case the flood experience and its regularity created a bond among the residents. Bridging relationships are social exchange relationships, which means they are relationships that have grown out of bonding relationships. These bridging relationships are broader connections that aid in disaster recovery [67]. Both relationships enable the community to assist one another by using alternative evacuation and disaster risk management methods. The linking relationship, which is an important component of social capital, cannot, however, be considered to have a strong presence. Linking relationships refer to vertical relationships that go beyond the community [67]. The [68] refers to this as relationship with “the different social strata in a hierarchy where power, social status and wealth are accessed by different groups” (p. 42). As illustrated in Fig. 4, while there are interactions between the community and various levels of government, the relationship and commitment are not as stringent. While Malabon was successful in convincing the DPWH that additional construction work on the polder dike and pumping stations was deemed necessary as part of the CAMANAVA Flood Control project, coordination with the DPWH in maintaining these infrastructures has proven difficult.

6. Conclusions

The road to urban resilience in Malabon City has been long and challenging. The city’s years of flood experience can be factored in the geographic and geologic make-up of the city as well as the country being in the path of the Pacific Typhoon Belt. However, having this knowledge and experience should have been part of the Metro Manila flood control plan from the start. Four factors are impeding Malabon City’s urban resilience process. The first two factors are a lack of transparency in project planning and implementation during the martial law period, resulting in poorly planned projects, and an unstable political environment. The imposition of martial law in 1972 was predicated on the country’s rising insurgency, and the flooding that occurred in Metro Manila and Central Luzon provided a suitable excuse for imposing emergency powers. Marcos’ monopoly on control and power over national government entities came with it. This permitted the Marcos administration to design and carry out projects without the need for congressional approval. Projects with exorbitant costs went ignored. Non-essential infrastructures, such as Imelda’s edifice complexes, which served as a symbol of their political power and control, were prioritized over critical public infrastructures, such as flood control infrastructure.

While flood control infrastructures were planned and implemented during the martial law period, the three main flood control infrastructure planned were concentrated in just one part of Metro Manila. It was also not completed since the Parañaque spillway,

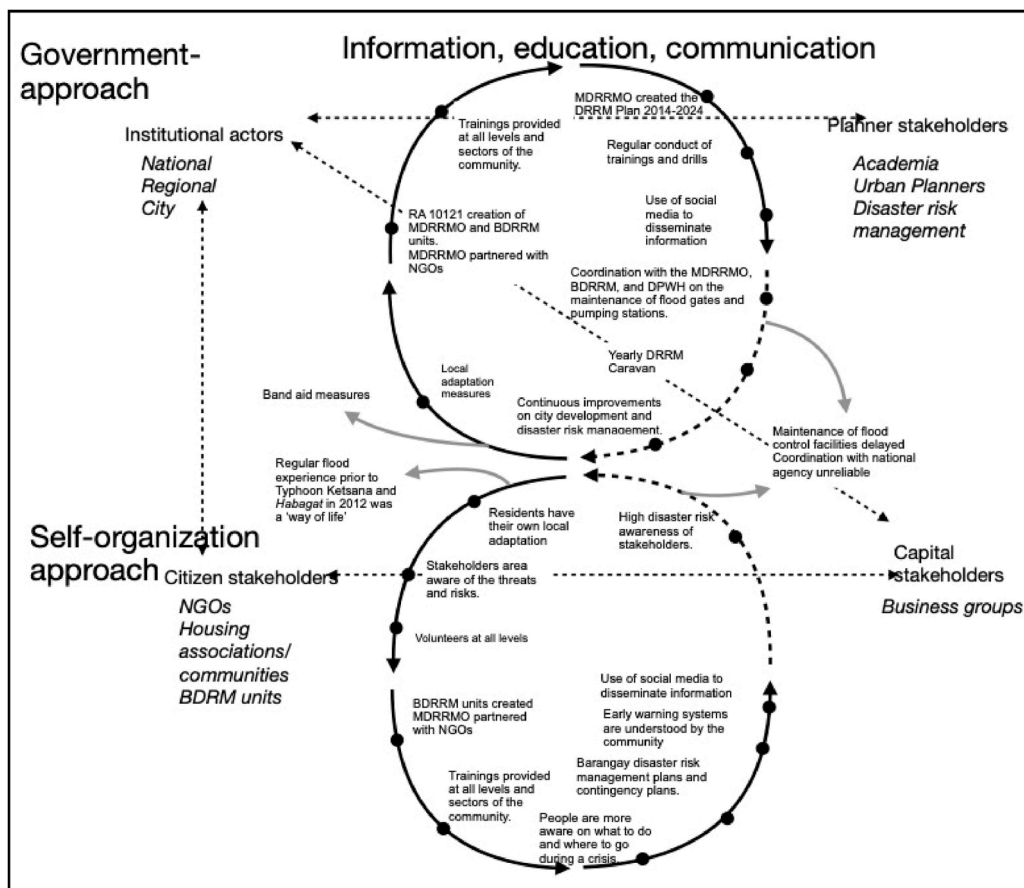


Fig. 4. Summary of Malabon's process of collective engagement and urban resilience. Source [11]:

whose costs more than doubled in two years, was never built (ironically) due to financial constraints. Furthermore, low-lying cities passed by the main tributary Pasig River, where the overflow from Laguna Lake will pass, only have pumping stations for flood control. This begs the question on who benefitted from these developments and on whose expense.

Pumping stations installed in the CAMANAVA region were not sufficient to address the floods. This lack of planning foresight overlooked the CAMANAVA's rising flood situation. Malabon's flood experience appears to have been the collateral damage of poor flood infrastructure planning and politicized project prioritization. This indicates that disaster resilience is highly political and value laden as project prioritization is made based on who to include and exclude for resilience opportunities. It makes the political-critical perspective on resilience by Ref. [14] very clear and relevant as resilience deals with 5 W's: the who, what, where, when and why of resilience, which are highly political questions. Further, in the late 1990s when planning for the CAMANAVA flood control program finally took off, delays in its implementation were still experienced due in part to the unstable political environment during that period. As a result, while flooding in one portion of Metro Manila has subsided, Malabon and its nearby cities continued to be flooded heavily.

The lack of accountability is the third factor slowing the process of urban resilience. Political insecurity at the national level resulted in the postponement of critical infrastructure construction in Malabon, which kept residents treading in flood water for decades, honing a "culture of disaster" which is "the constant threat ... has been integrated into the schema of daily life" [33]: 4). Findings of this study showed that Malabon's reliance on social capital meant resilience was focused on the community's ability to work together, "survive", and "bounce-back" from the flood. Although this has accelerated community resilience, governments also hide behind self-reliance and self-organization of communities, giving them arguments or better excuses to retreat and not invest in resilient solutions themselves or in cooperation with others. After all, governments are responsible for ensuring the safety and security of citizens in the face of any threat, yet communities self-organize to deal with the flood crisis because this is not evident. While these self-organization strategies may succeed in the interim, the government's continued failure or refusal to be accountable to its citizens will not generate overall resilience. This indicates that although resilience goes with community self-reliance it is never an excuse for politics and government to retreat from their responsibilities to support and enable communities, from an inclusive point of view, to become resilient in their daily practices [8].

Through the case of Malabon, the study demonstrates how resilience is an ongoing process. Malabon may have exhibited high human and social capital resilient drivers, but its economic and environmental capitals require further attention. The heavy reliance on

human and social capitals as drivers may have resulted in greater collective engagement and urban resilience at the community level rather than city level. According to the CEUR framework, engagement occurs not only at the local and community levels, but also at the regional and national levels. This brings us to the fourth and final factor, linking capacities, relationships between the Malabon City Government and regional and national government agencies, MMDA and DPWH, must be strengthened further. The MMDA's and DPWH's slowness and non-response burdens the community, which is forced to fix national government flood control projects immediately using their meager budget. A task they should not have been doing in the first place. This affects not only the community's finances, which can be used for other projects, but also their morale. This reinforces in them the "survivalist" mindset that they are on their own. This can have an impact on how they work with the city because it creates distrust.

Policies that place higher responsibility on the role of residents, communities, and society in resilience hides or even removes government responsibility and accountability. On the other hand, governments that exclusively decide on the development direction of their cities sidelines the very people they are supposed to serve. This stymies progress while also jeopardizing urban resiliency. The article shows that resilience is a complex concept that goes beyond simply bouncing back. The institutional capital of the city is the binding factor between all drivers of resilience, policymakers must provide an enabling climate for collaborative planning for collective resilience to work but they also must forge ahead in strengthening their economic and environmental capitals. The strong human and social capitals of a city may facilitate the process of community resilience but for the city to reach urban resilience the institutional, economic, and environmental capitals must also be strong. Since the latter set of capitals are tied with the regional and national governments it means that whatever happens at the higher government levels affect the city. This emphasizes the need for multi-level governance capacity. The Philippines unstable political climate gravely affected Malabon, as misplaced and poorly planned developments (Dagat-dagatan Reclamation Project) increased the flooding situation in the city, as well as the delays in the implementation of the CAMANAVA Flood Control Facility (impeachment of former President Estrada), prevented the city from reaching spatial and environmental resiliency. As we have seen in this article, resilience is about moving forward based on gained experiences and information, as well as employing and improving adaptive capacities not just the city's human and social capitals but also, its institutional, economic and environmental capitals.

7. Limitations of the research and potential future direction

The research is subject to some limitations. As stated in section 2 of this article, cities may be lacking in capital stakeholders involved in disaster risk reduction and management activities. This was true in the Malabon case, where we found no specific capital stakeholders involved directly in DRRM as such no one was interviewed. While the study may have gathered substantial qualitative data and derived analytical generalizations based on the targeted key stakeholders interviewed who have a direct involvement in the city's disaster risk management and urban planning initiatives, it may be interesting to learn about the perspectives of capital stakeholders on these topics. Another limitation identified at the conclusion of the study is the potential of biases in the scoring of collective engagement and urban resilience. While we paid close attention to the data derived from key informant interviews and focus group discussions, on which the scores were based, it could have made a difference if we cross-validated this with more interviewees. However, and this aligns with a third limitation of this study, is that we experienced time constraints for this comprehensive approach. We see this as a potential avenue for future research, which focused more on the variety of perceptions and interpretations of disaster-related resilience as this is also indicated in critical literature on resilience [69].

These limitations point to areas where research could be improved. First, we believe there is value in using a mix method of research where key informants interviews can be done in combination with a survey of a broader set of stakeholders throughout the city. This will aid in triangulating and cross-validating results. Second, to reduce biases, the scoring methodology can be improved further by allowing participants to score themselves. Finally, the CEUR framework provides a way for researchers, academics, and practitioners to understand the process of how different stakeholders can collaborate to build urban resilience through two approaches, the government and self-organization approaches, and it can be used to investigate other types of disturbances as well as develop other indicators under each resilience driver that can be tested.

Declaration of competing interest

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

Data availability

Further data can be found in <https://pure.eur.nl/en/publications/collective-engagement-from-disaster-prone-to-disaster-resilient-c>

Appendix 1. Drivers of resilience qualitative score description

Indicator	Indicator Logic	Scores	Qualitative scoring description
Human capital			

(continued on next page)

Indicator	Indicator Logic	Scores	Qualitative scoring description
Memory-based disaster experience	Studies revealed that people with long term residency in a disaster affected area refer to disaster experiences and memories on their perception of disaster risk (Bhattacharya-Mis and Lamond, 2014; Wilkinson, C., 2011).	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.
		2	Flood disaster experience normalized.
		1	Flood disaster experience remembered.
Social capital Social capital	Three types of connectedness form the basis of social capital, bonding, bridging and linking ties (Putnam, 2000 [68]; Woolcock, 2001).	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.
		2	At most two, bonding, bridging and linking ties present at the community level.
		1	None or weak presence of bonding, bridging and linking.
Institutional capital Policies	Institutions that have created a policy environment focusing on resilience and disaster risk management, participation, transparency, and communication allow action to become effective. Institutional capitals in this regard refer to the policies that mandates the city government to equip its stakeholders with the knowledge and information on disaster risk management.	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.
		2	Policies on disaster risk management partially present.
		1	Policies on disaster risk management not present.
Economic capital City gross domestic product	The gross domestic product (GDP) is the expenditure on final goods and services (OECD, 2018d) and measures the wealth of the city. The percent of the city's GDP in comparison to the country denotes the economic standing of the city in the country. The GDP of the city in comparison to the country's GDP is scored non-linearly where the narrower the gap between the two appears better.	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.
		2	The difference of the city GDP to the country GDP is 61 < 81 in ratio/percentage.
		1	The difference of the city GDP to the country GDP is 81 above in ratio/percentage.

(continued on next page)

Indicator	Indicator Logic	Scores	Qualitative scoring description
Economic diversity	A diverse economy allows a city to become resilient because it is not dependent on one economic sector. It also provides employment for people in a variety of industries.	5	City meets expected economic diversity.
		4	City moderately meets expected economic diversity.
		3	City has an emerging diverse economy.
		2	City has more than one economic source.
		1	Single economic source.
Environmental capital			
Climate and disaster proof infrastructures	The presence of climate and disaster proof infrastructures built in the city indicate the level and type of structural measures taken to mitigate and/or adapt to impending disasters. Infrastructures with the same type of functions indicate a fail-safe level.	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.
		2	Presence of climate-adaptive measures only in pocket developments.
		1	No hard preventive infrastructures or climate-adaptive measures.
Built up area	The percent of built-up areas to the area of the city highlight the city's density and exposure to hazards. The amount of built up areas increases the exposure of the population to risks. While it is understood that quality of infrastructure can be made better by either climate or disaster proofing measures, what is being measured by this indicator is the amount of exposure of the population to risks. Built up areas are scored inversely such that the score 5 has the lowest percentage of built up area, and 1 has the highest percentage. This denotes that a lower percentage of built up area is better in terms of vulnerability and exposure to risk.	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.

Source [11]:

Appendix 2. Collective engagement and urban resilience qualitative score descriptions

Indicator	Indicator Logic	Scores	Qualitative scoring description
Perception of risk and resilience	Perception of risk and resilience determines whether these concepts are understood and translated to disaster risk reduction and management actions.	5	Perception of risk and resilience translate to learning and improving knowledge on disaster risk reduction and management.
		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	Information, education and communication platforms contributes to knowledge and awareness and helps in strengthen capacities for collective engagement. Strengthens local knowledge and disaster experience learning.	5	Local knowledge and local adaption measures combined with knowledge sharing within networks

(continued on next page)

Indicator	Indicator Logic	Scores	Qualitative scoring description
Influence of social networks on collective engagement and urban resilience	Strength and reach of social networks increase the collective engagement of stakeholders through networking and engaging in discussion and activities on DRRM.	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
		5	Very high presence of social networks at all levels of stakeholders on DRRM. Engagement at all levels from community to city level.
		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.
		5	Locally organized groups recognized by the government and working with local government.
Mutual adaptation of roles in disaster risk management	Government and non-government actors recognize their mutual role in DRRM	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.

Source [11]:

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