UNIVERSITY OF THE PHILIPPINES
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MASTER OF ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT

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ENHANCING DISASTER RISK REDUCTION THROUGH COMPLEX ADAPTIVE SYSTEMS: AN ASSESSMENT OF METRO MANILA DRRMPS AND RECOMMENDATIONS FOR IMPROVED INTEGRATION

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03 May 2025

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July 18, 2025

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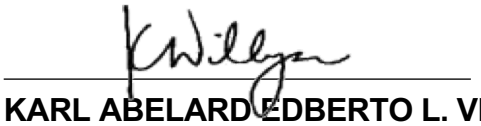

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DECLARATION

This is to certify that:

I. The special problem comprises only my original work towards the MENRM except where indicated in the Preface

II. Due acknowledgment has been made in the text to all other material used

III. The special problem is fewer than 25,000 words in length, exclusive of tables, maps, bibliographies and appendices.

Mary Lance B. Garcia
Name

Acknowledgement

The researcher would first like to give thanks to friends for providing much needed support through the construction of this research study.

The adviser of this research, Ms. Anita Rios, whose sound guidance and genuine personality made this project such a joy to work on.

The City of Las Piñas LGU, for kindly providing a copy of their LDRRMP through email upon request.

The professors and faculty members of the MENRM program, whose courses were filled with deep thought and inside that eventually ignited the spark for this undertaking. It has been an honor and a pleasure to have learned so much from all of you.

And last but not the least, the UP Open University institution, whose commitments to continuously providing quality, flexible and accessible education for all Filipinos has made it possible for OFWs like this researcher to obtain higher forms of learning in conditions where such an endeavor would have been nearly impossible.

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Abstract

This study serves as an exploration into disaster management frameworks that have been imbibed with principles from complex adaptive systems or CAS, herein referred to as *CAS-DRR integration*. As disasters in the modern age become more complex due to increased interconnectivity, it is essential for DRR practices to be made more flexible, adaptive, and innovative, and there is considerable evidence for CAS-DRR integration to be capable of addressing this need. This research looked into previous studies regarding CAS-DRR integration in order to extrapolate a content analysis matrix featuring the most commonly occurring themes. In this setup, the disaster management was framed as a complex system composed of three main subsystems: physical, social, and individual—the interactions among which produced a host of emergent properties and feedback loops that are characteristic of complex adaptive systems. This matrix was then used to examine selected DRR plans in Metro Manila to assess the current state of CAS-DRR integration within a local context. Content analysis showed that while Metro Manila LDRRMPs already contain strong policies and CAS integration to a certain degree, there is room for improvement in three main areas as stated in the recommendations: 1) Boost prevention and mitigation measures, 2) Boost the individual system through participatory approaches, and 3) Boost feedback loops and adaptive capacities through levelling.

Keywords: CAS; Disaster management; Complex adaptive systems; DRR; DRRM; Metro Manila; NCR; Philippines

I. INTRODUCTION

Largely owing to international agreements such as the Sendai Framework for Disaster Risk and Resilience policymakers, especially for the most vulnerable cities, have been shifting to promote a culture of awareness in the areas of disaster risk and resilience-building. This is propelled even further by the climate crisis, for which the Philippines consistently ranks as one of the most vulnerable countries in terms of impact. Technological advancements in recent decades have made for a more interconnected world, and while this has had a host of benefits across various sectors of society, it has also exacerbated the potential levels of complexity faced during moments of disaster. This discomfiting truth could be seen in the 2011 Great East Japan Earthquake, when a Mw 9.0 earthquake triggered off the coast of northeast Japan led not only to the largest earthquake in the nation's recorded history, but also a tsunami that inundated many cities and meltdowns of three nuclear reactors in Fukushima. By the end it took nearly 20,000 lives and, with economic damages estimated at 300 billion USD, has been cemented as the costliest natural disaster in human history.

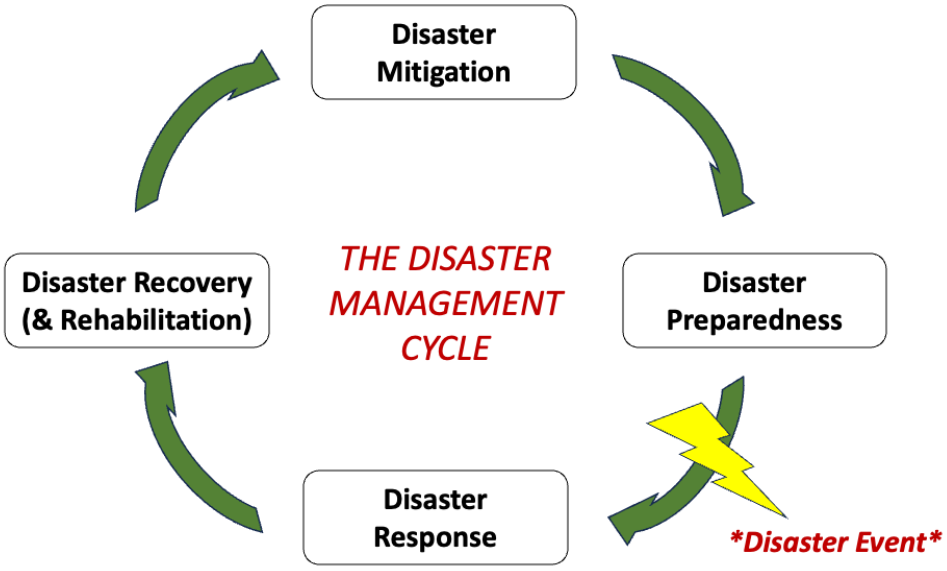
This interrelation of impacts brought about by natural disasters, not just on human lives but also on heavy infrastructure and transportation networks, has become a more frequent tale in the 21st Century. And we can expect that in the heavily connected world of modern society, the chance of such complex multi-disaster events occurring will only increase, thereby underscoring the need for up-to-date and innovative disaster management strategies that are capable of handling them. Existing literature reveals how DRR as a field evolved from its simpler origins, developing a variety of standard practices and frameworks. It has successfully made its way and defended its place into modern legislation. There is also an observable transformation in its principles, seen in the shift away from a more authoritative, "top-down" organizational approach where

individuals or groups in positions of power largely took control of disaster management, and towards one that is less rigid and more holistic, encouraging participation from non-government players and members of society. Aside from this, another concept that has taken hold of international DRR frameworks and local policymaking is that of resilience. Aligning with the principles laid out by the Hyogo Framework of Action, countries across the globe have been making their own strides towards resilience-building. But as disasters become more complex, DRR practices should also be fine-tuned to better accommodate the amount and intensity of unexpected outcomes. One way of achieving this is by integrating principles of complex adaptive systems. A burgeoning topic in the field of DRR, previous studies suggest that viewing disasters through the lens of complex adaptive systems has greater capacity than traditional DRR approaches for flexibility, adaptation, and overall resilience-building needed to deal with complex natural disasters. It presents a clearer and more granular view of the factors involved in a disaster event, and distributes power more evenly across various players (in this case, the stakeholders) in the system. By treating a disaster as if it were a complex adaptive system, delegation of tasks could be more easily defined, and problems that arise in the system could be addressed more efficiently.

Traditionally, disaster management is illustrated as a cycle of four main stages: *Mitigation, Preparedness, Response, and Recovery*—or 'MPRR', shown in Figure 1. Though there have been many variations to this, the core four elements remain largely the same. The cycle starts with the mitigation phase, ideally conducted long before a disaster event occurs. It is any effort to try to prevent a hazard from having significant impacts on the affected region, usually by strengthening building codes, research, and improving early warning systems. An awareness of a possible forthcoming disaster triggers the preparedness stage, where the necessary supplies are obtained and evacuation measures are enacted where necessary. Immediately after the disaster is

the response stage, usually the heaviest of the four, where the community mostly deals with the direct impacts of the disaster through search and rescue and relief operations. When some time has passed, the community can look into the recovery phase, where things are brought back to “status quo”, moving back towards the normal functioning of people’s daily lives.

Figure 1. The MPRR Model. A cyclical model that serves as the foundation for DRRM.



Complex Adaptive Systems or CAS is a framework that conceptualizes systems as being composed of simpler units, all of which exhibit their own self-organizing properties and interact with each other, and with the environment, in ways that produce effects that are high in complexity (Carmichael & Hadžikadić, 2019). This is in contrast with the simpler and more straightforward linear or even cyclical models of cause and effect. In a usual linear cause and effect scenario, factors in the system can be assigned attributes and their interactions could easily be modelled by mathematical equations. In the case of a CAS, interactions are not so easily simplified by mathematical formulae due to their nonlinearity. There are also elements such as feedback, adaptation, and emergence which add to the dynamic CAS environment. In summary, within a CAS, even relatively simple players with simple rules of behavior can produce complex

properties that may not have been initially accounted for in planning. Whereas most models in DRRM attempt at a great degree of control, in reality, much of how we see disasters unfold is complex and unpredictable. This does not mean that disaster management should be conducted merely on a basis of “wait and see what happens”, rather, modern models should learn to study this complexity and be altered for adaptability. A more adaptable model would have increased self-awareness at all stages, identifying key players, seeing opportunities where they arise, and even taking advantage of unexpected phenomena that may arise from the system. These are all features inherent to the CAS approach.

CAS-DRR integration is still a relatively new concept in academia, but one that shows great promise for especially disaster-prone countries like the Philippines. By examining DRR plans in the countries against a CAS-DRR framework, a baseline picture of the strengths and weaknesses in DRR policymaking could be formed, and recommendations could be made for further study into ways that CAS-DRR integration might be utilized across the country.

II. REVIEW OF LITERATURE

A complex adaptive system was defined by Abbott & Hadžikadić (2017) as a system wherein *"large numbers of constituents independently interact on a local level that yield some unanticipated nonlinear outcome at scale."* At its core, this is what a CAS is. When examining the properties of CAS, it is generally agreed on that these constituents, or "agents" are self-similar, in that they are homogenous within themselves yet heterogenous from one another. They operate on their own set of rules and exhibit their own set of behaviors—a feature termed as *self-organization*. It is when these constituents interact with each other and the environment that we begin to see the more distinguishing properties of CAS that give it its dynamic nature: *a) adaptation, b) feedback,* and *c) emergence.*

Adaptation in a CAS could also be termed *learning* or *evolution*. This process could take place on the level of the individual agent, or on the system as a whole. System-level adaptation occurs when multiple agents change in a manner that is somewhat interrelated as a response to environmental input, a process that could take place across many fields of study. In general, adaptation as a feature sets a CAS apart from traditional linear to cyclical models wherein systems are assumed to be more static. Feedback, on the other hand, means that *"the outputs of a system at time t affect the inputs of that system at time t+1"* (Carmichael & Hadžikadić, 2019). This implies that in a CAS setting, the results of agents interacting with one another may influence future interactions, resulting into a feedback loop. Emergence occurs when the CAS exhibits emergent behaviors—phenomena that are the result of rules and interactions of agents at the micro-level but are generally observable on the macro-level or larger scale. The manner in which these properties lend more flexibility, adaptability, and complexity to a system increases the potential of CAS to be applied to many other fields of discipline

that requires the study of large and complex systems, with examples ranging from ecosystems to financial markets to ant colonies and economies. With how broad the coverage is of DRRM, along with its often-interdisciplinary structure, there is also great potential in the study of integration of CAS and DRRM.

Carmichael & Hadžikadić (2019) also pointed out that the CAS framework directly challenges the hierarchy bias, defined as *"the tendency to view a complex system in terms of a leader directing the activities of all the other agents."* This essentially defines the top-down organizational structure that often features heavily in traditional DRRM, where the leader is often the state or governing body tasked with the burden and responsibility of spreading awareness and getting citizens prepared and safe in times of disasters. Modern frameworks on DRRM have been more encouraging of the participatory approach, which taps into all sectors of the community in the organizing of DRRM strategies as a means to decentralize decision-making from the government. The CAS integration approach could help further in achieving this.

The study of Miller et al. (2025) highlighted an approach to disaster and emergency management (DEM) that integrated principles of complex adaptive systems in the face of disasters that have been growing more and more complex. In it, they outlined the development of the disaster management field from its origins in the more traditional "phased approach"—a framework which divided disaster management into the mitigation, preparedness, response, and recovery (or 'MPRR')—to ones that more embodied the traits of nonlinearity and adaptability for which complex adaptive systems are distinguished. They emphasized the need for DEM to evolve towards being more dynamic and flexible, able to adapt to changes in real-time, and decentralized from top-down, government agency-centric approaches by encouraging community participation. The resulting framework, termed Complex Adaptive Disaster and Emergency

Management or CADEM, addressed these with its emphasis on decentralized coordination, networked problem-solving based on emergent properties, and multiple overlapping networks designed to accommodate stresses in the system even if one point were to fail due to some cause. The strength of CADEM, they claimed, is in *"its ability to enhance resilience through emergent adaptation."* This incorporation of emergent properties within a DRR context is a distinguishing feature of CAS-DRR integration.

The idea of using CAS as a means to expand DRR perspectives is not entirely a new one. In 2016, Coetzee et al. sought to find commonalities between resilience and CAS studies in order to extract a more streamlined definition of resilience. They found that resilience is often confused with its close relative "stability" in literature, and this confusion could have major impacts in policymaking. While the latter implies the return to a steady-state—or equilibrium—in the aftermath of a disturbance, resilience should be acknowledged as being beyond just that. The ability to return to the status quo after a disaster is not enough to grant a community resilience, as it was those original stable conditions which created their vulnerability to the disaster in the first place. Stable systems lack the ability to adapt and hence, resilience must not be viewed as a mere outcome that we seek to achieve, but rather a continuous process of learning from past experiences and building back better. This dynamic process indicates a "feedback loop"—a feature that not only characterizes complex adaptive systems but also lends it non-linearity. The study outlined 5 CAS concepts that could be used in viewing disaster resilience: *1) non-linearity, 2) aggregation, 3) emergent behavior, 4) feedback loops and adaptation,* and *5) context-based responses*.

CAS-DRR integration is again highlighted in the study of Burger et al. (2021), which defined three specific subsystems working at play in disasters: *1) the physical*

system, consisting of geological, ecological, and human-built systems *2) the social system,* consisting of informal and formal collective behavior, and *3) the individual actor system,* consisting of actions and decision-making on the individual level. In this setting, each subsystem interacts with the other two, and a change in one subsequently impacts the two others as well. This study also highlighted specific properties of CAS that could be adapted into disaster research. Namely, heterogeneity, webs of connections, relationships and interactions, and adaptations arising from individual actions, decisions, and learning. Studying the dynamics of the three subsystems could lead to revelations about adaptations and emergent behaviors in the DRR-CAS, however research tends to be more inclined to concentrate on just one of them.

One other way that CAS-DRR integration shows promise is in its potential to boost community-based, participatory approaches to disaster management. Getting the community more aware of disaster and engaged in DRRM initiatives has been a main goal of Philippine DRRM offices in the past decade. Increasing the decision-making capabilities and responsibilities of the community encourages decentralization, easing a significant burden from what may be overworked and underfunded DRRM offices. This community participation could come from marginalized groups like women and persons with disability, as stated in the Sendai Framework of Action. Countries like Japan would apply this in their choice to utilize disaster victims and their unique ability to transmit local knowledge of past disasters (Pisa, P.F., 2024). The study highlighted that when the information came from the victims themselves—usually through the form of disaster memorials—memory transmission is highly effective. This underscores the need for a platform that allows a community to learn important lessons from past disasters without necessarily having experienced it themselves. It also shows that while a traditional top-down model for DRRM would make it challenging to foster a culture where individuals

are more engaged in DRRM efforts, a framework that accounts for any individual player's unique form of knowledge and talent could go a long way towards achieving this.

As of this writing, there are no known studies exploring CAS and DRR jointly within the context of the Philippines. However, pursuant to the Disaster Risk Reduction and Management Act of 2010, local government units in the country are mandated to produce their respective local disaster risk reduction and management plans or LDRRMPs. These documents are provided by each city and municipality's DRRMO unit and provide a localized bird's eye view of disaster management perspectives in their respective jurisdictions. Content analysis of these plans (Ner et al., 2022) found that LDRRMPs in the National Capital Region tend to strongly integrate resilience attributes in governance, risk identification, financial consideration, societal capacity, infrastructure protection, and preparation and response. Most of these can be attributed to traditional top-down approaches and policymaking, for which the Philippines has had much experience in handling due to its higher-than-average exposure to natural hazards. However, almost all cities were found to be lacking in the areas of ecosystem protection, survivors' participation in recovery, and city-to-city learning—the latter two being key traits in the societal, bottom-up movements heavily featured in CAS-integrated DRR frameworks. This implies that adopting a complex adaptive systems perspective when creating and evaluating DRR strategies in the country may greatly contribute to addressing the weaknesses found in the 2022 study of Ner et al., leading to better overall resilience.

III. STATEMENT OF THE STUDY

The evolution of CAS-DRR integration in academia has been marked by a few notable studies that looked into how the complex adaptive systems approach could innovate the disaster management field and boost efforts in aligning with international agreements such as the Sendai Framework for Disaster Risk Reduction, or SFDRR. Though the concept has been adequately explored, it has yet to establish itself in global literature well enough to develop its own set of standard vocabulary and conceptual frameworks. Rather, similar concepts are coined with slight variations across different studies, and new ideas are still being introduced. This study makes an attempt at finding the commonalities across these works and combining them into a cohesive framework that is then overlaid onto a Philippine DRR context. Through this, disaster planning in the Philippines could be evaluated on a range of themes commonly associated with CAS-DRR.

The goal of this study is not to undermine current DRRM efforts in the country, as a look into the policies and community programs over the past decade reveals how much progress has been made since the implementation of Republic Act 10121, or the Disaster Risk Reduction and Management Act of 2010. Rather, it seeks to assess the current state of DRRM in the Philippines against the backdrop of the SFDRR and other modern concepts in DRRM. It is important that planning is kept self-aware and up-to-date, and this could only be achieved through periodic evaluations and finetuning of approaches. With the recommendations set forth in this study, it is the hope of the researcher that this finetuning process could be simplified and made straightforward.

IV. OBJECTIVES OF THE STUDY

This study aims to summarize current trends in the field of CAS-DRR integration, and assess how well local DRR plans integrate principles of CAS. The specific goals of this study are as follows:

- To identify similar themes in pre-existing literature that feature CAS-DRR integration and summarize them into a matrix,
- To assess selected LDRRMPs in the National Capital Region using a content analysis matrix that would measure how well they perform in certain thematic areas associated with complex adaptive systems, and
- To formulate suggestions for better CAS-DRR integration in the Philippines that would boost resilience efforts in the country.

V. RATIONALE

There have been several studies on the integration of CAS into DRR, particularly with regards to resilience-building. In the Philippines, strong legislative measures and policies are already in place, largely due to the enactment of RA 10121, also known as the Disaster Risk Reduction and Management Act of 2010. This established the National Disaster Risk Reduction Management Council or NDRRMC, and mandated governments at the regional and local levels to form their own localized DRRM offices. Policies like this, along with the nation's host of other environmental laws are the result of decades of periodic and reoccurring disasters that have impacted its natural and economic landscapes. While this was undoubtedly a step in the right direction, there is considerable basis for the need to reassess current disaster management strategies given that DRR as a field has evolved much in the past few years. Unlike traditional DRR principles, modern DRR has a more in-depth and systematic understanding of disaster management, has a complex view of risk, and aims to relieve some burden from higher power entities by encouraging a more participatory approach to DRR, where the entire community is engaged in one or more forms of activity. This contrasts heavily with the traditional "top-down" approach that Philippine policymakers have relied on for a long time. As one of the countries that are most vulnerable to natural hazards and the worsening climate crisis, DRR strategies in the Philippines must be revitalized to be in line with modern international frameworks and trends within the field.

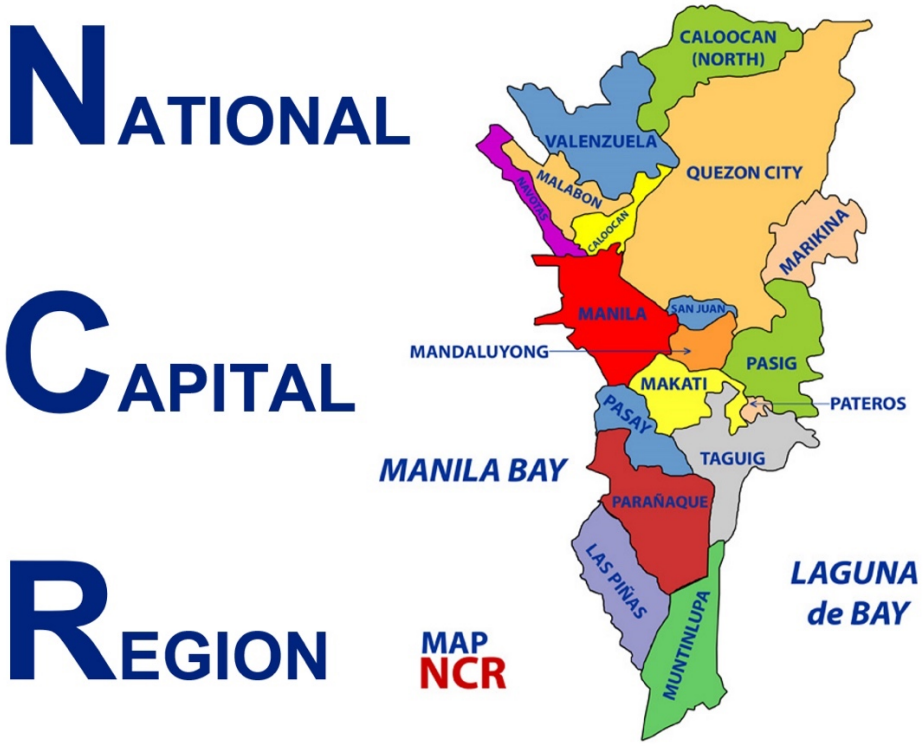
VI. SCOPE AND LIMITATIONS

In assessing the state of disaster planning in the Philippines, much insight can be gained from studying Metro Manila, a region also known for being among the densest megacities in the world. In 2010, enactment of Republic Act no. 10121 mandated the creation of the NDRRMC, a government agency specifically for disaster management, and the National Disaster Risk Reduction and Management Plan or NDRRMP. This effort is to be mirrored by local government units in their respective disaster management offices and plans, termed as LDRRMPs.

Metro Manila is comprised of 12 LGUs each with their own LDRRMPs. This study looked into three of these plans—Quezon City, Makati City, and Las Piñas City. These documents, along with the NDRRMP, are available in the public domain per the government units' official websites, with the exception of Las Piñas, which was very kind to send over their LDRRMP upon request via email. The researcher recognizes that the conclusions drawn could be improved by analysis of more Metro Manila LDRRMPs, and highly recommends that as a point of further study for future endeavours.

VII. DESCRIPTION OF THE STUDY AREA

Figure 2. A map of the National Capital Region (from https://ncr.cpd.gov.ph/socio-demographic-profile/).



The National Capital Region, also known as Metro Manila, is the capital region of the Philippines and the economic and administrative center of the country. It is composed of 16 highly urbanized cities: Manila, Caloocan, Las Piñas, Makati, Malabon, Mandaluyong, Marikina, Muntinlupa, Navotas, Parañaque, Pasay, Pasig, Quezon City, San Juan, Taguig, and Valenzuela, and the municipality of Pateros. Under the Köppen classification system, Metro Manila mostly has a tropical wet and dry climate, with temperatures ranging mostly from 15 °C on the lower end to 39 °C on the higher end.

With its population of 13 million people over an area of 636 sq. km, it has an astounding population density of 21,765 people per sq. km., making it one of the densest urban regions in the world. Aside from its residence, the abundance of business and

employment opportunities in the region also attracts a significant “daytime population” of people who commute to Metro Manila for work or studies even though they reside in the surrounding regions. These factors significantly increase the number of people exposed to hazards in the event of a disaster, particularly if the timing were to hit during conventional working hours. The region is periodically exposed to typhoons and flooding, particularly due to the presence of lowlands, floodplains, and major channels like the Pasig River and Marikina River within its bounds. Its proximity to the Manila Trench situated on the West Philippine Sea offshore to the west also means that a high-magnitude earthquake generated by tectonic movement could trigger a tsunami that would sweep along the coast of Manila Bay. Active faults like the Marikina Valley Fault System also traverse the eastern portion of the region. One segment of this fault system, the West Valley Fault, has been a significant cause for concern, as historical records show that it is capable of generating a magnitude 7 earthquake—a hypothetical event dubbed as “The Big One”—that would cause major destruction in the city’s capital, crippling major business and government activities for a significant period of time. It is for this reason that LGUs in Metro Manila should ascertain that its DRR strategies are solid and able to account for complexity.

VIII. METHODOLOGY

The primary mode of analysis used to assess the collected DRR plans is that of direct content qualitative analysis. This method is commonly used to assess text-based data which will then undergo a deductive process based on preexisting theories and frameworks that were used to derive specific “codes” or themes in the source material. In the case of this study, these source materials are four official disaster management documents in the Philippines: The National Disaster Risk Reduction and Management Plan (NDRRMP) and three Local Disaster Risk Reduction and Management Plans (LDRRMPs) in Metro Manila—those of Quezon City, Makati City, and Las Piñas City local government units.

The content of these DRRMPs were assessed for their integration of CAS concepts using the software QualCoder 3.6, a free and open-source software for qualitative data analysis. The use of Computer-Assisted Qualitative Data Analysis Software (CAQDAS) has been a prevalent methodology for qualitative research across many disciplines for the past three decades, with many programs now being widely available (Brailas et al., 2023). QualCoder possesses all the main features of a CAQDAS and imports them into a simple and beginner-friendly interface, making it very accessible without needing to sacrifice rigor and depth in the process. Its open-source nature also means that it is constantly being updated and adjusted in response to user feedback. It has provided support for many researchers from various disciplines. Its website lists over 200 peer-reviewed studies that have used the program, with fields ranging across EFL education, sustainability studies, geology, psychology, and many more (Curtain, n.d.)

For the purposes of this study, CAS elements were divided into two main strands of theory: the first and second order CAS elements. First order CAS elements are those that form the building blocks of the complex systems in a disaster. These are the physical, social, and individual spheres as defined in the framework of Burger et al (2021). Second order CAS elements are higher derivative traits that naturally arise from the interactions of these spheres, and whose existence are indicative of a complex adaptive system in place. Though there are many more concepts that fall under this category, this study focused only on the two that are most often featured in existing literature: Emergent Behaviors, and Feedback Loops & Adaptation. This is not meant to conflate the terms feedback and adaptation, as there is a nuanced difference between the two. However, for the purposes of this analysis, it is assumed that feedback behaviors often encourage system-level adaptation and vice versa, thus they were categorized broadly under the same code.

Figure 3. Framework for CAS-DRR integration based on Burger et al, 2021.

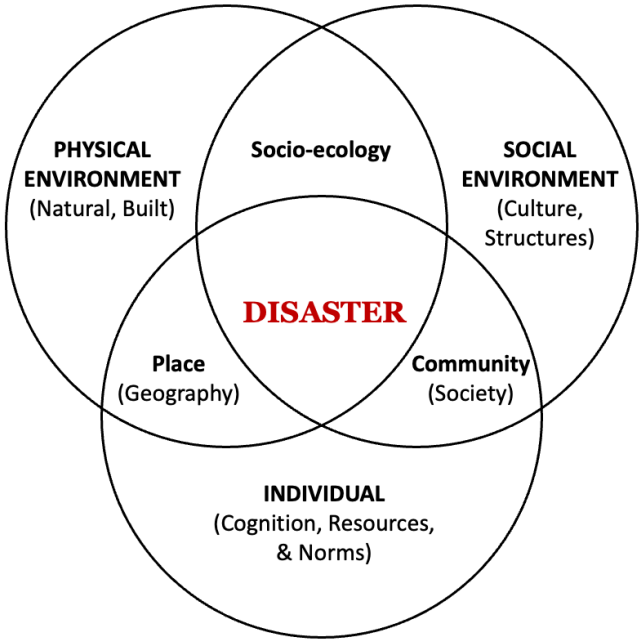
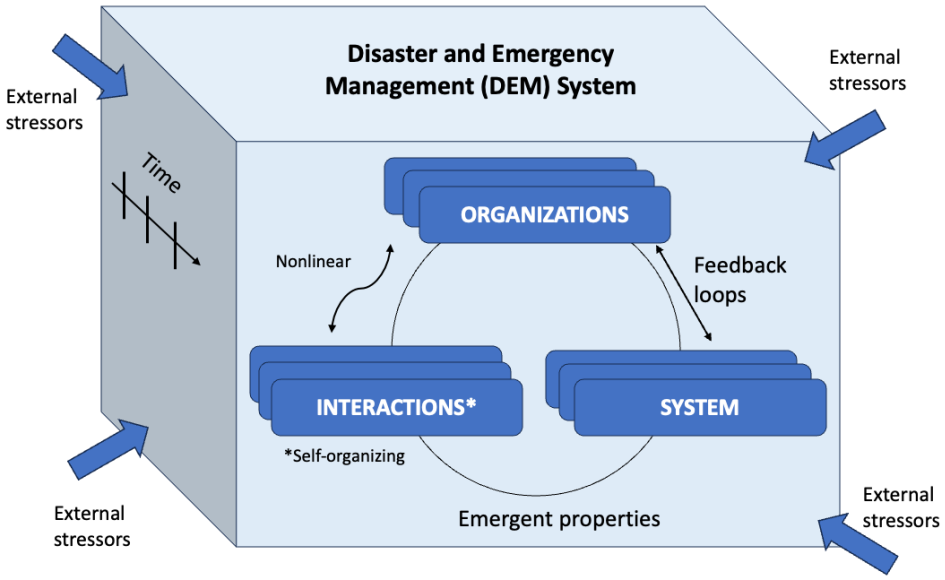


Figure 4. Framework for CAS-DRR integration based on Miller et al, 2025.



Combining the frameworks of the two studies led to the deductive content analysis matrix below, through which the DRRMPs were evaluated:

Table 1

Content analysis matrix. Content analysis matrix detailing the coding scheme used in this study

Theory	Codes	Subcodes	Reference
1st order CAS elements	Physical (Establish context)	Built (infrastructure, housing) Natural (weather, hazards)	Burger et al., 2021
	Social (Top-down)	Structure (government, networks) Socio-economic factors	Burger et al., 2021 Lloyd, et al., 2022
	Individual (Bottom-up)	Resources (skills,	Burger et al., 2021

		knowledge) Cognition & norms	
2nd order CAS elements	Emergent Behaviors	Evolving risk Innovative response	Miller et al., 2025
	Feedback Loops & Adaptation	References to past disasters Continuous process	Coetzee et al., 2016; Miller et al., 2025

The actual codes used in the content analysis were assigned numbers from 1 to 10. These are listed below.

Table 2

List of codes. Codes or themes serving as focal points for content analysis, along with their descriptions

Code	Name	Description
1	Built	Infrastructure, building codes, reinforcing
2	Natural	Ecosystem protection, environmental laws, natural hazards, ecological properties
3	Socioeconomic/ Vulnerability	Considerations for marginalized groups (women, low-income households, PWDs, etc.)
4	Structure	Governance, policymaking, international frameworks, implementation, network
5	Cognition & Norms	Culture-specificity, indigenous body of knowledge
6	Resources	Volunteers, individual actors, CSOs
7	Evolving Risk	Increased complexity and intensity of disasters and risk

8	Innovative Response	Decentralization, holistic approach to disaster management
9	Continuous Process	Updating and continuous refining of DRR plans and strategies
10	References to Past Disasters	Mentions of, and lessons learned from, past disasters

IX. RESULTS

Outcomes and the Thematic Areas

Following the format instigated by the NDRRMP, each DRR plan exhibited a list of desired outcomes detailing priority areas in the government body's disaster management strategies. Each of these outcomes fall under one of the four thematic areas in the NDRRMP framework: 1) Disaster Prevention and Mitigation, 2) Disaster Preparedness, 3) Disaster Response & Early Recovery, and 4) Disaster Rehabilitation and Recovery.

These so-called 'pillars' of DRRM were introduced in the older version of the NDRRMP in 2010, meant to be aligned with the Mitigation-Preparedness-Response-Recovery or MPRR model of disaster management. By categorizing the outcomes under at least one of these pillars, a big picture snapshot is revealed of what area each plan aims to prioritize in their actions, especially as these outcomes make up the most substantial, info-dense portion of each document.

Table 3

Outcomes per thematic area. Frequency and percentage of outcomes per thematic area

Thematic Area	NDRRMP f (%)	Quezon City LDRRMP f (%)	Makati City LDRRMP f (%)	Las Piñas City LDRRMP f (%)
1) Disaster Prevention and Mitigation	8 (35)	6 (22)	11 (30)	6 (19)
2) Disaster Preparedness	4 (17)	5 (19)	5 (13)	4 (13)
3) Disaster Response & Early Recovery	5 (22)	9 (33)	14 (38)	17(55)

4) Disaster Rehabilitation & Recovery	6 (26)	7 (26)	7 (19)	4 (13)
Total	23 (100)	27 (100)	37* (100)	31 (100)

Note: Makati City's LDRRMP's Outcome 7.5: "Disaster-resilient health facilities" was categorized under 1) Disaster Prevention and Mitigation, as well as 3) Disaster Response and Early Recovery.

Priority Codes

Each plan's list of outcomes also underwent content analysis coding, for which each one was assigned the theme of best possible code. The codes that were reflected in the outcomes are herein termed "priority codes". A frequency bar graph of these priority codes was made for each DRRMP. Note that these bar graphs are not meant to imply that the goal is to achieve equal distribution across all codes. Rather, they are merely meant to serve as guides as to which themes are most prevalent in the DRRMP's objectives.

X. ANALYSIS AND DISCUSSION

HFA vs SFDRR

Before scaling down to the per-plan level, it is important to establish the international agreements frequently referenced by each of these plans. Namely, these are the Hyogo Framework of Action (HFA), and its more modern successor the Sendai Framework for Disaster Risk and Reduction (SFDRR).

The HFA was an international agreement made in 2005, which greatly influenced the stipulations of RA 10121. It aimed to create a culture of disaster awareness during a time when the field of DRR was little known, and the full impacts of the climate crisis have not yet been realized. Ten years later, nations convened once more in crafting the SFDRR agreement, now armed with a better picture of climate change and knowledge of complex disasters such as the 2011 Great East Japan Earthquake and Tsunami.

The updated NDRRMP explicitly stated the need to update DRR attitudes from the HFA model to the SFDRR one. In it, they cited three main differences between the two. These are summarized in Table 4.

Table 4

HFA vs. SFDRR. Differences between the HFA and SFDRR principles of disaster management, according to the NDRRMP

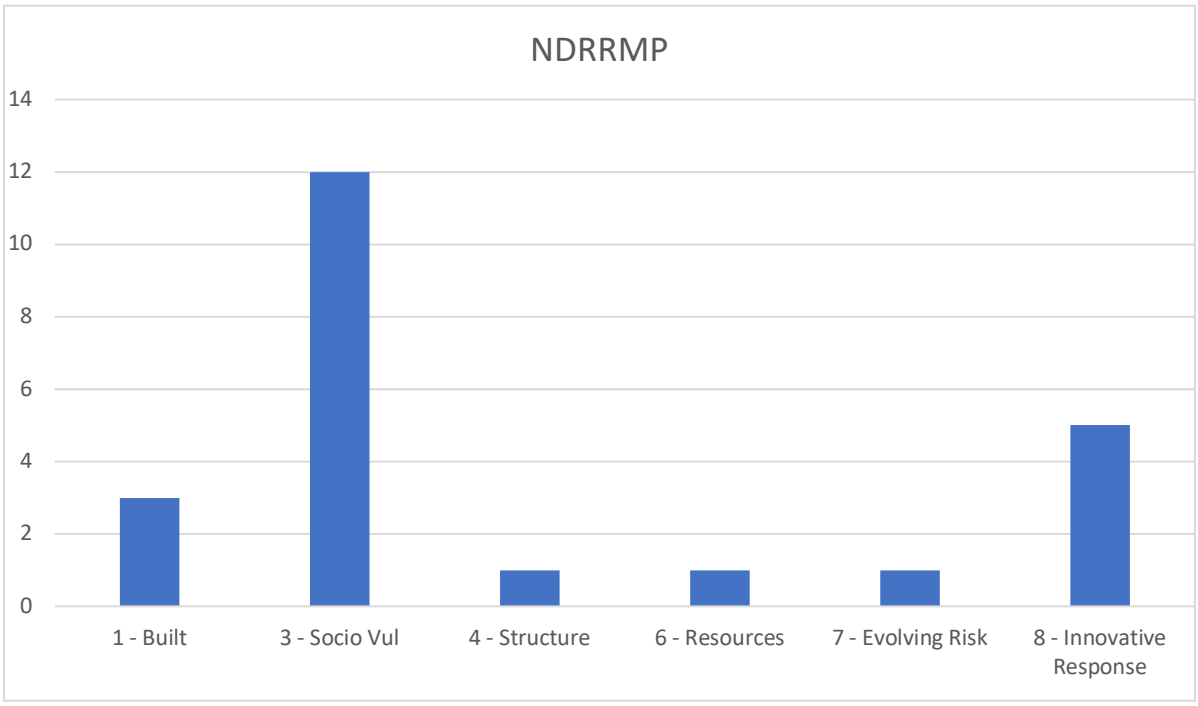
HFA	SFDRR
• Static risk. The HFA had a foundational understanding of risk and made no allusions to its dynamic nature.	• Evolving Risk. he SFDRR paints a clearer picture of how risk has the ability to change over time and will continue to do so especially in the face of climate

• Vulnerability. Attributed to the presence of marginalized groups. • Risk-centered approach. The HFA was focused on raising awareness of how risk-centered approaches would benefit planners.	change. It is in many ways more complex than before. • Vulnerability. A result of systemic arrangements with more complex underlying factors. • Risk-centered approach. The SFDRR assumes that awareness has already been achieved, and thus moves towards more action-oriented applications.

The NDRRMP

When the four pillars of DRRM were introduced in the old NDRRMP, equal significance was placed on each. But, following the principles agreed on in the SFDRR, the updated NDRRMP put a heavier emphasis on Disaster Prevention and Mitigation. The idea behind this is that investing heavily in mitigation would reduce adverse impact from disasters, and therefore reduce the need for resources put in the other three. This was a remarkable step away from the more reactive approaches exemplified in DRRM policies prior. This paradigm shift was reflected in the NDRRMP's list of outcomes, a majority of which (35%) were indeed marked under the Disaster Prevention and Mitigation theme.

Figure 5. NDRRMP priority codes.



By far the most frequently occurring code in the NDRRMP's list of outcomes was 3 – Socioeconomic and Vulnerability. These outcomes were mostly focused on livelihood support for vulnerable sectors, provision of basic services, and implementation of policies that would increase the community's access to reliable and timely information. The NDRRMP also had significant occurrences of code 8 – Innovative Response, which mostly centered on the "mirroring" strategy. This encourages the establishing and capacitating of regional and local DRRM offices that would mimic the national level strategies, thereby decentralizing power—and in effect the burden of DRRM—from the national government. Furthermore, the NDRRMP is grounded and aware of local projects, often highlighting examples of good practices being done in specific regions. This plays an important role in potentially extending the effects of effective, yet small-scale projects to a wider audience. It also references a handful of past disasters experienced throughout the country—although this is mostly constrained to typhoons and flooding.

While the NDRRMP mentioned milestones of progress since the enactment of RA 10121, it is aware of the challenges in the current Philippine DRRM landscape that still warrant attention. It states: *"Overall, while much interest was put in the development of risk assessment approaches and materials to guide governments and communities to understand the underlying drivers of risk, how these were translated into actions, budgets and priorities in the mandated policies and plans is another matter. Planning processes were mostly still not risk-centered and much can be improved in connecting the dots – from tools to assessments to plans and budgets. These also show how agencies have yet to work alongside each other and that efforts to promote synergy across institutions and mechanisms need to be strengthened."* This fragmented atmosphere in DRR implementation can be seen in the LDRRMPs as well. And while there appears to be a strong level of connection amongst government agencies reflected in DRR plans, there usually exists a disconnect between government bodies and the community. This is why the NDRRMP's focus on access to information is important, and should be at the forefront of local DRRM plans. Furthermore, it underscores the need for community-based DRRM. A DRRM plan that is community-based encourages people from all sectors of society to engage in disaster management, and is complementary to decentralization efforts made by the government. More active community participation is also one of the key factors in CAS-oriented DRR. Despite this, while the NDRRMP does not ignore the significance of community participation, its operative language is more centered on the sharing and passing on of information to citizens rather than on cultivating a culture where these people take this information and use them to take on more active decision-making roles.

As an official national government document designed to set an example for LGUs, it is to be expected that the NDRRMP would feature significant authoritative and “top-down” tones in its content. Still, the lack of a robust participatory DRRM model is discordant with one of the key principles of the SFDRR, which they’ve claimed to have based their updated framework on. In contrast with the NDRRMP, the SFDRR contains a section which clearly lays down the roles of several non-government players in DRRM. The fact that this wasn’t assigned the same level of importance in the NDRRMP is concerning, as it lends LDRRMPs tasked with mirroring the excuse to gloss over it in their objectives as well.

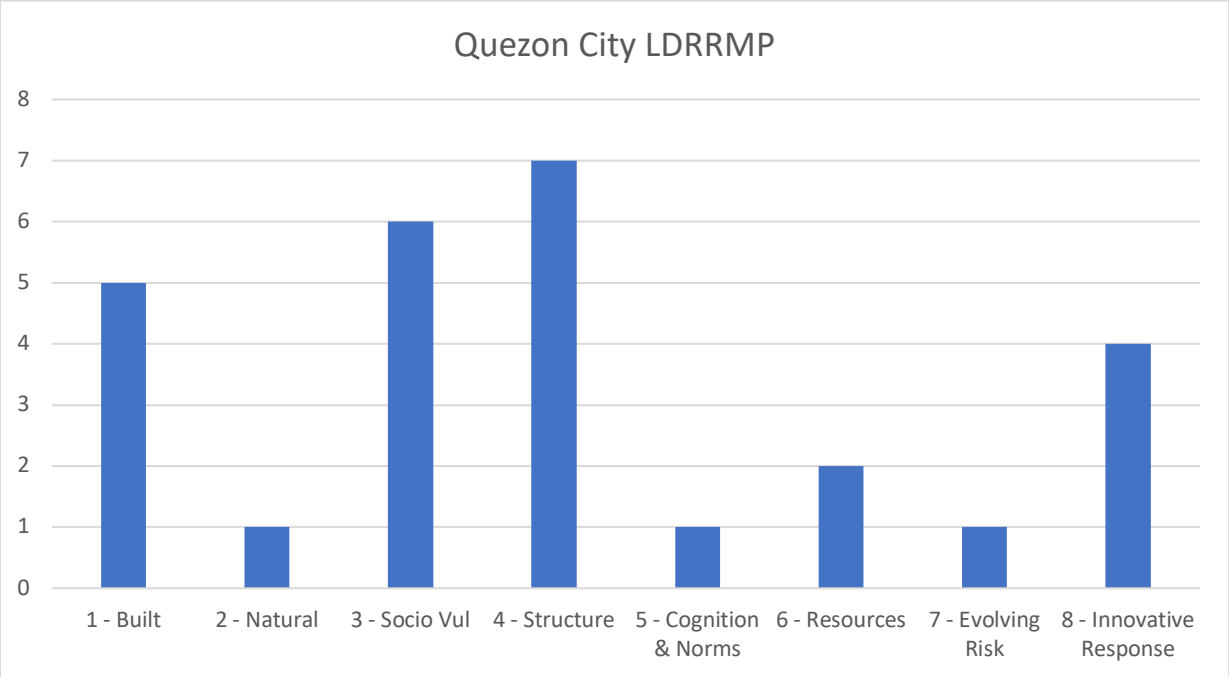
Overall, it can be assumed that the key principles and strategies espoused in the NDRRMP will greatly influence its local counterparts, especially in cases where the concerned LGU might not have adequate resources on its own when crafting their DRR plans. The NDRRMP does its best to collect ground-level data and form a birds-eye view of the DRRM landscape across the country, giving a glimpse as to the state of DRRM nationwide. When looking at the passages coded with 2nd order CAS elements 7 – Evolving Risk and 8 – Innovative Response, the NDRRMP appears to have a decent level of CAS-DRR integration, particularly in its emphasis on decentralization, the mainstreaming of DRR with climate change adaptation, the role of academia and ecosystem protection in DRRM, and the importance of context-based risk assessments. These are no small feats, and they lend the NDRRMP good credibility. But care should be taken as the mirroring model adopted by government units creates a sense of a “trickle-down” of information from the national to local scales, where more complex, in-depth DRR concepts take some time to pass through from higher to lower constituents, thereby slowing down progress in the field. Boosting the Individual System components (codes 5 and 6), which have strongly related themes

to community-based DRR, could balance this out and lubricate the information channels and feedback loops in the complex DRR system.

Quezon City LDRRMP

Of the 27 outcomes listed in the Quezon City LDRRMP, a majority falls under the Response & Early Recovery (33%) Recovery & Rehabilitation (26%), with Prevention & Mitigation only coming third at 22% and Preparedness being the last at 19%. The most frequently occurring themes were 4 – Structure, 3 – Socioeconomic/Vulnerability, and 1 – Built. Quezon City also has the highest variance in outcome codes out of all the DRR plans studied, as it is also the only one to have at least one outcome coded with 5 – Cognition & Norms.

Figure 6: Quezon City priority codes. Variance = 8.



Quezon City aligns itself with the NDRRMP in its adoption of the four thematic pillars of DRRM, establishing councils for each one, and with the SFDRR in its frequent mentions of the “Build Back Better” principle of resilience in its Disaster Recovery &

Rehabilitation section. This sound structuring of its DRRM office and the teams and councils working in each division, along with its references to the SFDRR and the UN Sustainable Development Goals give the impression that this LGU has a formidable stance in policymaking and implementation. It has an in-depth understanding of underlying risk drivers and how socioeconomic conditions factor in disaster risk. Its risk profiles are comprehensive, ranking each barangay's level of risk in terms of earthquakes, flooding, and combined impacts. With the COVID-19 global pandemic as one of the main instigators, Quezon City is also commendable in its multi-hazard approach to disaster planning, which aims to incorporate geophysical, hydrological, atmospheric, human-induced and biological hazards. This well-rounded approach is vital to managing the most populated LGU in the National Capital Region.

There is also a strong commitment to the continuous refinement of DRR policies, exemplified in the emphasis on Monitoring and Evaluation: *"There is a prevalent notion in the current planning practice of the Philippines: rather than a continuous cyclical process, planning is considered as a simple process of producing a plan document or project with 'time start' and 'time finish' elements. Monitoring and Evaluation (M&E) addresses this continuity gap by linking one planning cycle to the next by providing feedback or information on the results/assessment of plan implementation and on how the next year's activities can be undertaken to better achieve local goals and objectives."* This is reflected in the LDRRMP framework, which shows a cycle of actions as opposed to a linear chain.

Out of all the plans studied, Quezon City has the most comprehensive coverage of human-induced hazards, a section of hazards which neither the NDRRMP nor RA 10121 established a baseline for, but all population-dense and high crime rate LGUs would greatly benefit from.

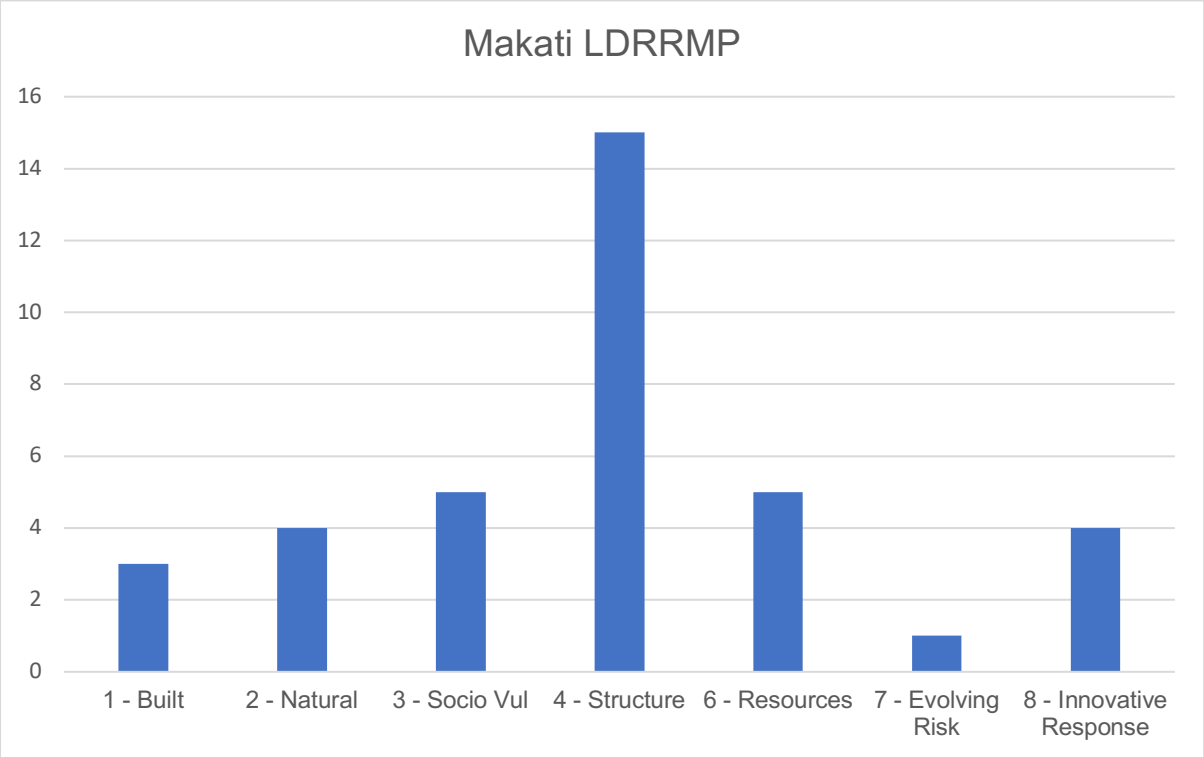
Another thing to note about the Quezon City LDRRMP is how it is the only document to have an outcome coded with 5 – Cognition & Norms. This was Disaster Prevention & Mitigation outcome no. 4: *"Communities use and maintain timely, responsive, context- and culture-specific early warning systems."* While all the other plans highlighted, to some degree, the importance of communities having access to disaster information that is relevant to them, only Quezon City's phrased it in such a way that they take on an active role rather than in the passive voice as is the more common approach. Its theoretical understanding of the participatory approach is robust, citing an "inclusive and all-of-society approach" as one of its guiding principles towards resiliency. Despite this, the "bottom-up" approach is only a minor note in the overall plan and pales in comparison to the more Structure-aligned themes. It also gives no explanation as to how to implement its projects in a way that would be culturally-specific to its population, nor does it suggest ways to incorporate specific individuals in decision-making, as per SFDRR principles. Rather, it mostly sees the community in blocks and groups, each with their own roles, and not as individuals with specific knowledge to potentially contribute.

With regards to the 2nd order CAS elements category, while Quezon City performed well in 8 – Innovative Response and 10 – Continuous Process, in large part due to its comprehensive multi-hazard approach and cyclical frameworks, it contained little to no acknowledgement of the concept of evolving risk and lessons learned from past disasters—whether in Quezon City or other regions. There is a mention of how *"Other LGUs that have undergone disasters can be used as benchmarks"* in their SWOT analysis, indicating a willingness to participate in city-to-city learning, but this was never expanded on in the rest of the plan.

Makati City LDRRMP

The Makati City LDRRMP has 36 listed outcomes. 38% of these outcomes is under the Response & Early Recovery category, 30% is under Prevention & Mitigation, 19% in Recovery & Rehabilitation, and 13% is under Preparedness. The most prevalent themes for these outcomes were 4 – Structure, 3 – Socioeconomic/Vulnerability, and 6 – Resources.

Figure 7. Makati City priority codes. Variance = 7.



Furthermore, this plan contains very comprehensive profiles on the area's environmental features in terms of topography, hydrology, and climate. While other DRR plans also had their own ecological profiles, Makati City makes an effort to connect these natural features with the risk an area is exposed to. An abundance of risk maps also makes this information easy to digest. This provides adequate context and data for barangays to work with in forming their own DRR plans. There is explicit acknowledgement of the role that a healthy natural ecosystem plays in DRR, and how

planning in both areas should go hand-in-hand. Its vulnerability profiles are relatively well-informed, frequently referencing the GMMA RAP study conducted by various government and academic institutions regarding a worst-case earthquake scenario for the Greater Metro Manila area.

A stronger theme of DRR education and information sharing also distinguishes this plan from others involved in this study. Strengthening and utilizing educational institutions appears to be the LGU's main strategy towards decentralization. For this reason, the plan performs well in code 6 – Resources. This is reflected in two of their projects: the DRRM Community Organization, Participation and Empowerment (COPE) program, which *"involves the initiatives and strategies for strengthening the connectedness and engagement of communities from DRRM planning to implementation as well as equipping them for self-help, mutual-help, and public-help"*, and the Risk Information Services program, which *"aims to ensure the availability and timely provision of risk information for planning and decision-making purposes as well as allowing the communities to take the necessary actions before hazards hit."* This means that Makati City's plans for CBDRRM are a bit more elaborate than other LDRRMPs.

Alongside DRR education, the Makati City LDRRMP also adopts clustering of barangays as a means for decentralization. Here, barangays are grouped into 6 clusters with the goal of implementing common projects and ensuring more effective utilization of resources. Clustering also encourages cooperation within each cluster, such that they could easily provide necessary resources should any one member find themselves in need of assistance. This effectively relieves much of the burden from higher-level LGU authorities and increases decision-making responsibilities on the more localized tiers.

In terms of performance along the 2nd order CAS elements codes, Makati City

has well-rounded passages under 8 – Innovative Response, with strategies that integrate climate change adaptation, DRR education, and environmental protection. It contains a commitment to the continuous refinement of its response plans and several references to past disasters under various hazard types. However, though an understanding of evolving risk is implied throughout the plan, it is never specifically described.

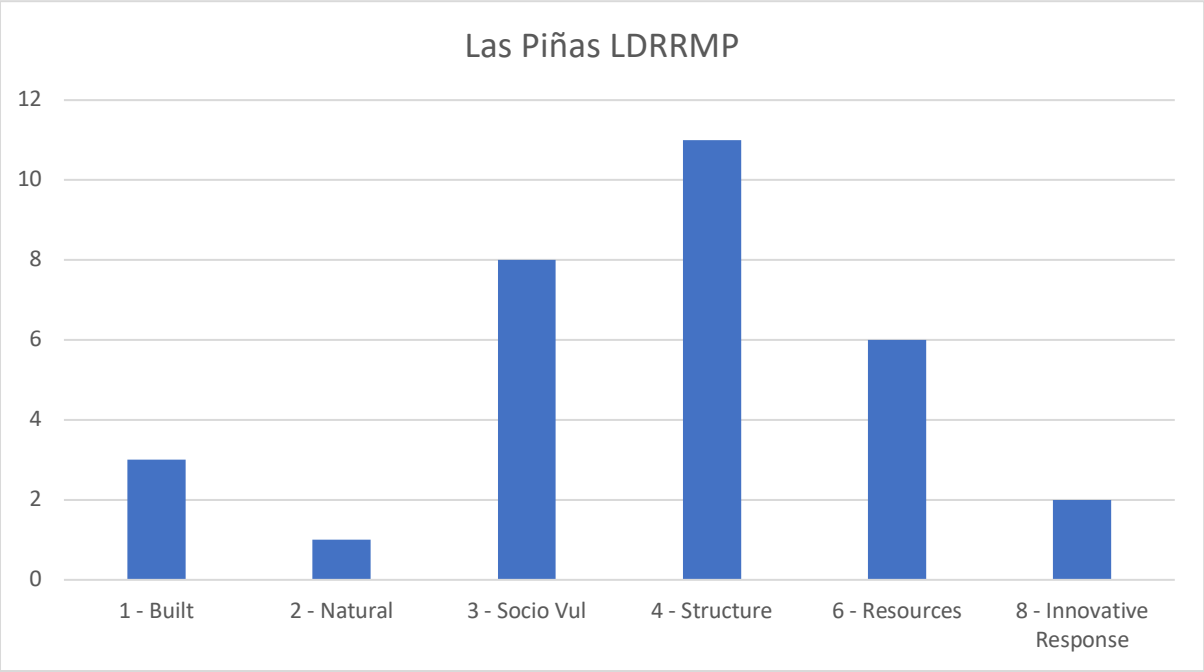
Overall, while the Makati City LDRRMP shows a thorough understanding of vulnerability, community-based DRRM, and holistic DRR strategy, it is undeniable that code 4 – Structure still dominates its narrative. This, however, does not necessarily mean that the LGU is at fault for being forceful or authoritative, but could be simply a reflection of the current state of DRR affairs in the country. For as much as Makati City would like to include more participatory, "bottom-up" themes in DRRM, effective CBDRRM could only be realized if the citizens involved are adequately empowered and informed. Makati City's LDRRMP shows that the first step towards this is investment in the strengthening of educational institutions and channels for information sharing. We can see this in the wording of Outcome 3.2: "Communities *are equipped* with necessary skills and resources to cope with disasters", as opposed to *"Provide* community members with necessary skills…" which has an undoubtedly more authoritative tone. While a robust participatory approach seems to be out of reach for the time being for most LGUs, the fact that Makati City has stated this as an outcome shows their view that it should, eventually, be the norm in Philippine DRRM.

Las Piñas City LDRRMP

Out of the 31 outcomes listed in the Las Piñas City LDRRMP, over half (55%) fall under the Response & Early Recovery pillar. The remaining three categories share

near equal portions, with Prevention & Mitigation in second place at 19% and Rehabilitation & Recovery and Preparedness tied at 13% each. The most frequent code for these outcomes is that of 4 – Structure, followed by 3 – Socioeconomic/Vulnerability and 6 – Resources.

Figure 8. Las Piñas City priority codes.



Compared to the Quezon City and Makati City LGUs, the Las Piñas LDRRMP is more skeletal, owing perhaps to how it lacks the same economic power and access to funds that the other two have. How it conducts its DRRM is therefore of great interest as it provides an example of how smaller entities could operate with limited resources. One way the plan copes with this is by heavily relying on prior Metro Manila-wide studies like the MMEIRS and the GMMA RAP as the LGU does not have the means to conduct comprehensive risk assessments for itself. Using these reports, ecological and risk profiles of Las Piñas were generated. While this does not overtake the significance of localized risk assessments, it underscores the importance of standardized regional studies for LGU DRRM planners that have no local surveys to reference.

Las Piñas City also has a grounded assessment of its risk to an earthquake

generated from the West Valley Fault, as this is a focal point of the GMMA RAP. Though the city itself does not contain any of the fault segments, it acknowledges other factors that would endanger it, such as soil quality and infrastructure soundness. Furthermore, it references past earthquake disasters such as the 1968 M7.3 earthquake in Casiguran, Aurora, and the 1990 Baguio earthquake, acknowledging lessons that can be learned from these events with regards to ground shaking and liquefaction. This explicit referencing of historical disasters, whether or not they occurred in the locality sets the Las Piñas City LDRRMP apart from even the more technologically robust plans of Quezon City and Makati City. It speaks to the important role data management and lateral distribution of information play in DRR.

Despite this, the Las Piñas City LDRRMP feels the most outdated of all the plans studied, in the sense that its approach to DRRM is more in line with the HFA framework than with the more modern and holistic SFDRR. The overwhelming focus on the disaster response stage is concerning, and the document has strong authoritative top-down tones. While it is to be expected that a number of LGUs would not have access to the same funding and resources as Quezon City and Makati City, the disparity across NCR—the smallest economic region in the country by land area—warrants some attention. For as much as LGUs are given their own independence and autonomy in most matters, natural disasters like supertyphoons and high-magnitude earthquakes do not restrict themselves to political boundaries. As the effects of these disasters are often widespread, rather than being isolating and competitive, DRRM planning should be fluid, allowing for an exchange of resources across these boundaries, and should be collaborative by nature.

Addressing the 'Big One'

Though not as recurrent as typhoons and flooding, earthquake risk remains a significant matter of concern amongst the LDRRMPs studied, largely due to the presence of the active West Valley Fault, a 130 km-long segment of the Valley Fault System which transects the cities of Marikina, Quezon City, Pasig, Taguig, and Muntinlupa. Geological studies of its seismic behavior indicate that it has produced large scale earthquakes of magnitude 7 or higher in the past at a recurrence interval of about 400 to 600 years. Given that its last movement was in 1658, it is probable that another major event could occur at any given moment. This event has been dubbed as “The Big One”, and was modelled in the GMMA RAP study envisioning a magnitude 7.2 event—the estimated maximum size that the WVF could produce.

Under GMMA RAP’s estimations, an earthquake of this size could lead to around 37,000 fatalities mostly due to building collapse, and 605,000 injuries. It also estimates that 40% of residential buildings would be completely destroyed under such a scenario. The impacts are expected to be immense, both economically and in terms of casualties, because the WVF traverses a most population-dense region in the country. It refers to the affected area as the “Greater Metro Manila Area”, a region encompassing Metro Manila and the surrounding provinces of Laguna, Rizal, Cavite, and Bulacan. These figures are referenced often in the LDRRMPs studied, and were used as a baseline for earthquake risk assessment on a local level.

The cities of Quezon City and Makati identified specific barangays that were traversed by the WVF, identifying these as areas of high earthquake risk. Quezon City also released an Executive Order creating the “West Valley Fault Task Group”, tasked with focusing on earthquake mitigation measures within the 5 to 10-meter buffer zone of the faultline.

Makati City’s strategy also looks into other earthquake-related hazards—

ground shaking, ground rupture, and soil liquefaction, generating city-wide hazard maps for each. In referencing the GMMA RAP casualty and economic impact figures, it lays out the data in a factual and concise manner, utilizing illustrations and larger fonts for points of great concern. This conveys a greater sense of urgency and makes such data easier to digest by other planners who look onto the city's LDRRMP as a basis for their projects. Finally, there is a section on "Estimated Effects per Barangay", which projected casualty figures based on the GMMA RAP magnitude 7.2 earthquake scenario for each barangay.

Las Piñas City is the only one out of the studied areas which does not have a part of the WVF running through it, but it is explicitly mentioned in their document that this does not exempt the city from experiencing adverse effects from the Big One.

XI. RECOMMENDATION AND CONCLUSION

In framing disaster management as a complex adaptive system, we recognize that the CAS is composed of first and second order elements, each of which is vital to the fundamental acts and maintenance of the entire system. The first order elements are three subsystems, each with their own set of parts, functions, inputs and outputs: 1) Physical subsystem, 2) Social subsystem, and 3) Individual subsystem. The interactions among these subsystems, as well as the internal workings in each, could affect the whole CAS environment. Thus, in DRRM it is important to have in-depth understanding of these subsystems and the way they organize themselves and harmonize with one another.

Aside from the first order CAS elements, 2nd order CAS elements like emergent behaviors and feedback loops also play an important role, and are inevitable outcomes in a CAS setup. Emergent properties are generated from interactions of the system's actors rather than predesigned. This means that a DRR plan that adequately prepares for, and takes advantage of, emergent behaviors would be better capable of handling a complex disaster. This is one of the biggest distinguishing traits of CAS-DRR from traditional DRR, which has often relied on more rigid structures. Where traditional DRR would be phased or hierarchical, CAS-DRR sees unpredictability as an opportunity. It encourages flexibility and interdisciplinarity and utilization of local knowledge—all of which being modern trends in the field of DRR. The presence of feedback loops is also essential to a CAS. In a DRR context, these would be multidirectional channels of information that allow the system to learn from its experiences and consequently adapt to its current situation, making sure that the CAS is never stagnant. This could be greatly facilitated by a focus on DRRM education and

more robust data management systems.

With these in mind, this study presents three key recommendations for better CAS-DRR integration in Metro Manila:

1) **Boost prevention and mitigation measures**

The NDRRMP endorses a model of DRRM that puts Disaster Prevention and Mitigation at the forefront, a significant departure from traditional practices which have historically been focused on the post-disaster stages of DRRM. Despite this, the Metro Manila LDRRMPs gathered in this study still had outcomes that mainly fell under the Response and Early Recovery stage, signifying that DRR in Metro Manila is still primarily reactionary. But in the same way as the adage *"Prevention is better than cure"* is oft-repeated with regards to human health, so it holds true in disaster management. A shift to a more proactive stance in disaster prevention would reduce the strain on manpower and resources that frequently cripple even stable economies in the aftermath of a disaster. In practice, the listed outcomes and projects in LDRRMPs should have a majority of its focus on pre-disaster stage actions through comprehensive risk assessments that are area-specific and context-based.

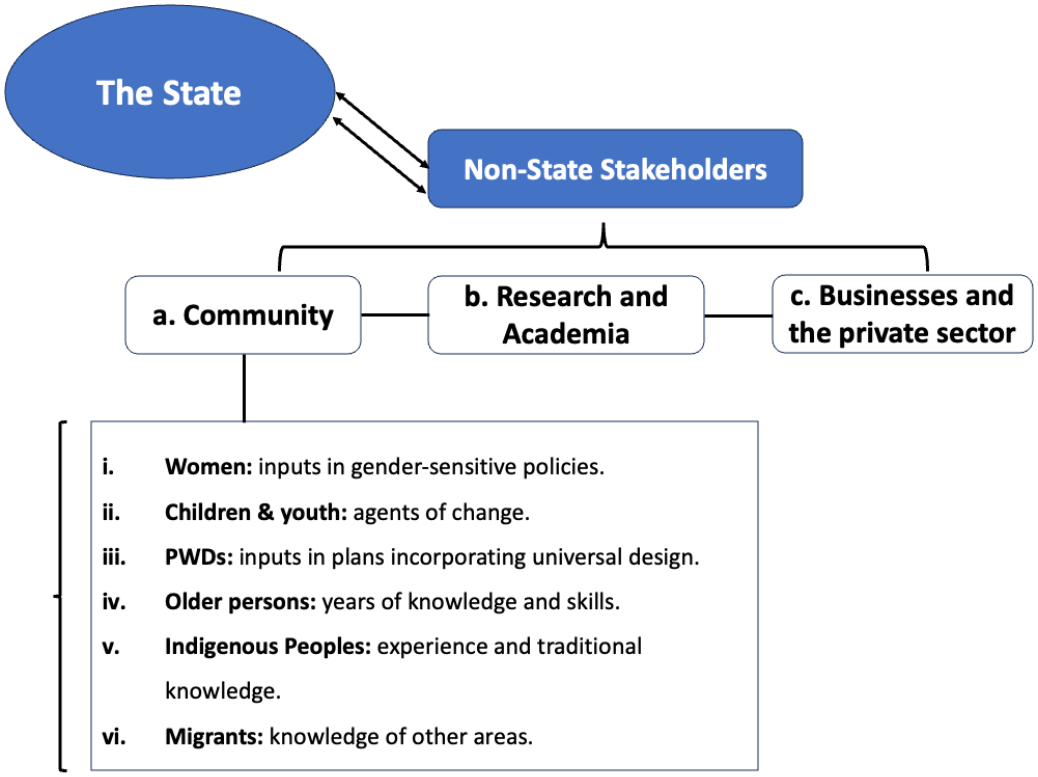
2) **Boost the individual system through participatory approaches**

While community-based DRRM has been touted as a priority by DRRM offices over the past decade, the NDRRMP and LDRRMPs in this study contained only vague descriptions of how they aim to integrate participatory themes in their projects. As the NDRRMP stated, much has been achieved in raising awareness and fostering a culture of disaster preparedness since the

enactment of RA10121 and the establishment of the National Disaster Risk Reduction and Management Council. Research institutions like the UP Resilience Institute and DOST-PHIVOLCS have also made great strides in improving risk maps and early warning systems for various hazards nationwide. This momentum could be harnessed further by tapping into citizens as a resource for DRRM projects. The LDRRMPs in this study mainly looks at the community in blocks or groups—whether they be CSOs, businesses, or the youth. While this is a step in the right direction, in order to foster a community that is truly engaged in DRRM it should recognize untapped potential in each member. The fact that none of the DRRMPs examined had an occurrence of Code 5 – Cognition & Norms (save for Quezon City, which had one unelaborated mention) shows that understanding of culture and trait-specific contributions of individuals to DRRM remains poor in the Philippines. What distinguishes a participatory plan is that it does not merely stop at acknowledging the existence of marginalized groups and generating projects to assist them, it looks into specific knowledge that they might harness and incorporates them alongside technological, science-informed approaches into planning. For example, women and persons with disability or PWDs could be tapped into as a resource on how to make DRR plans more inclusive, and indigenous peoples could be consulted on their knowledge of their localities. The SFDRR itself suggests a way to achieve this in Section V. “Role of Stakeholders”, which is summarized in Figure 7. The study of Ner et al. (2022) goes a step further by including even disaster survivors as an untapped resource in disaster planning. While unconventional, it is a practice that is already being done in Japan, where disaster memorials frequently have victims

as their central sources. Disaster victims provide emotional weight to the physical impact of disasters, an element which has been shown to improve memory transmission across members of society (Pisa, 2024). This means that disaster victims can be great contributors to DRRM by keeping memories of long-past disasters alive, and making sure lessons get passed onto the next generations. The participatory approach, alongside improvements in disaster education, ensures that people need not have personal experience of disasters in order to learn from them.

Figure 9. SFDRR-based framework for a participatory approach to DRRM.



3) Boost feedback loops and adaptive capacities through leveling

In order to ensure that the DRR complex system remains flexible and adaptive, it must be diligent in managing historical data and capable of learning from past

disasters. For LGUs, this means making sure that data management systems are robust and adequately utilized in planning. This is particularly important for entities that lack funds for DRR, such as with the case of Las Piñas City, where their study of past disasters in the country allowed them to draw reasonable conclusions for their own risk factors. Furthermore, the Las Piñas City LDRRMP showed that this referencing of past disasters need not be specific to the area. Lessons could also be learned from disasters that affected other regions, and should thus be effectively communicated so as devastating impacts are not repeated.

This study then reiterates the findings of Ner et al. (2022) regarding the importance of city-to-city learning, which was found to be severely lacking in Metro Manila LDRRMPs. As it is, LGUs are mostly autonomous bodies whose DRR strategies show great disparity regardless of how closely related they are in terms of geography, hazards exposure, and location. Information usually follows a “trickle-down” movement, where efficient strategies start at the higher tiers like the national government and are filtered through localized bodies. This phenomenon stalls progress and is counterproductive to CAS-DRR integration. To address the disparity in DRR strategies across Metro Manila, efforts should be made to level with one another in a process herein termed as *leveling.* In leveling, information flows aren’t merely vertical top-down, they are also lateral, fair, and collaborative. Leveling encourages LGUs with access to more resources to share snippets of what they have learned with more economically vulnerable LGUs.

Aside from leveling, much could also be learned from Makati City’s heavy

investments in DRR education. Partnering with educational institutions would make information dissemination significantly more efficient, and also increases opportunities for members of marginalized groups to engage in DRRM.

Conclusion

CAS-DRR integration could reasonably be performed in Metro Manila by taking on a more holistic and all-of-society approach to DRRM. In order to achieve this, the national government and LGUs should devote their efforts to improving mitigation measures as opposed to reactionary ones. These measures are typically performed pre-disaster, and would ensure that impacts from disasters are not as severe as they could be. Second, a participatory approach is highly encouraged. The framework for involving and utilizing various members of society in DRRM has been laid out in the Sendai Framework of DRR, yet has not been explicitly acknowledged by the LDRRMPs in this study. The participatory approach shows great promise in decentralizing the burden of decision-making from government bodies, and ensures that individuals are better equipped to handle disasters. Furthermore, it acknowledges specific areas of knowledge of individuals and aims to incorporate this knowledge in planning. Lastly, the strategy of leveling is highly recommended to equalize information and capacities across neighboring LGUs. Leveling emphasizes lateral instead of top-down spread of information, and encourages city-to-city learning, giving less economically wealthy LGUs a chance to catch up with more privileged neighbors. This is particularly important in the case of the Big One, the devastating effects of which would severely impact Metro Manila and its surrounding regions without regard for political boundaries. Given that residents of the Greater Metro Manila Area are all exposed to this threat, DRRM planning should be fair, robust, and consolidated. The

GMMA RAP study from 2014 shows how valuable a region-wide assessment can be to leveling the DRRM strategies of within Metro Manila LGUs, particularly for ones that do not have the means to conduct comprehensive assessments for themselves. There is great potential in exploring the initiation of and collaboration on similar projects, one that is kept up-to-date periodically by the very people it is designed to serve.

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