

Evaluating the Egyptian Flood Mitigation toward Resilience

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This paper evaluates the flood mitigation strategies employed by the Egyptian government to increase resilience to flooding. Existing literature in the field of disaster risk management highlighted the urge to shift the focus from response and recovery to mitigation. It is argued that in order for this shift to occur, it is necessary to integrate disaster management, community awareness and preparedness. Current practices in developing countries seldom reflect such a synthesis, and this is one of the reasons why hazard awareness is absent from local decision-making processes. Policy reviews and community initiatives are traced to explore the effectiveness of Egyptian's system in reducing the impacts of flooding on vulnerable populations and its potential to increase the resilience of communities to future floods. Therefore, it highlights the government's challenges in implementing these strategies. We argue that realising the available resources and tools for flood mitigation strategies in developing countries requires different measures and procedures due to the magnitude of challenges facing the government, therefore, community resilience is one of the key factors in this process. Accordingly, this paper provides recommendations for further research and policy development.

Keywords: Disaster risk management, flooding, strategic planning, climate change, resilience

Introduction

Climate change and its associated impacts, particularly sea-level rise (SLR), pose significant global challenges, with natural disasters potentially causing annual direct asset losses of \$300 billion, escalating to \$520 billion when considering impacts on human well-being (Hallegatte et al., 2017). Floods, which inflict severe damage, are especially devastating in lower-income nations with underdeveloped infrastructure. The global nature of this threat is underscored by recent events in countries such as Bangladesh, Nigeria, the United States, and Vietnam. During COP 26, the UK Prime Minister warned that cities like Alexandria, Miami, and Shanghai could be submerged if action against rising temperatures is not taken. Egypt, where the population is concentrated along a narrow strip of land by the Nile and coastlines, faces recurring flood challenges. Despite ongoing mitigation efforts, the country remains highly vulnerable. This paper evaluates Egypt's flood mitigation strategies, assessing their effectiveness in reducing community vulnerability and providing recommendations to enhance resilience against future floods (Agrawala et al., 2004).

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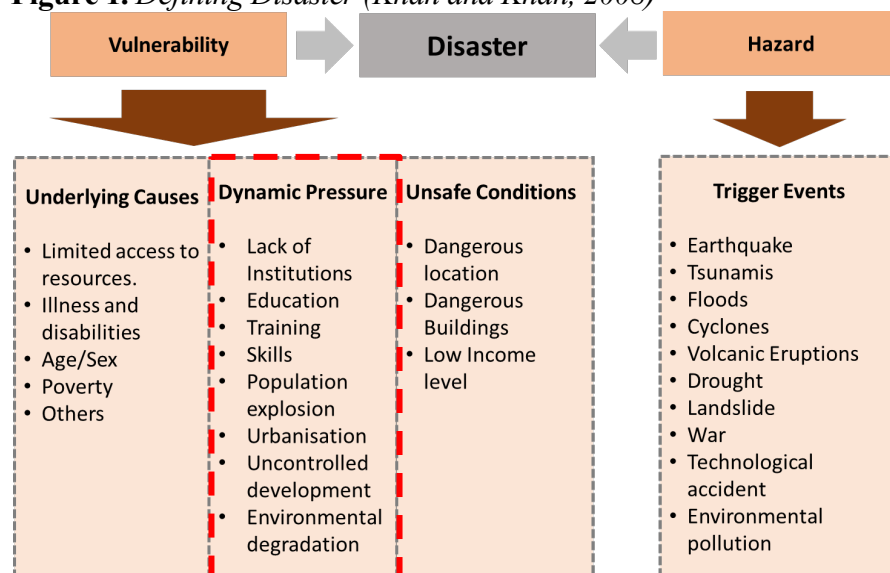
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Disaster Risk Management

Disasters are unforeseen occurrences that result in significant property damage and fatalities (Moore and Lakha, 2006). Hazard, vulnerability, inadequate capacity or protective measures for property, and negative effects on the environment as shown in Figure 1 combine to create disaster (Khan and Khan, 2008). Research and practice in disaster management often use the following formula (Flanagan et al., 2020): $\text{Risk} = \text{Hazard} * (\text{Vulnerability} - \text{Resources})$. Risk is the expectation of loss, Hazard is a state that poses a danger of damage, Vulnerability is the degree to which people or things are likely to be impacted, and Resources are the assets that will lessen the consequences of hazards (Dwyer et al., 2004; UCLA Center for Public Health and Disasters, 2006).

The literature on disaster management is replete with theories, models, and techniques for dealing with calamities (Nojavan, Salehi and Omidvar, 2018). The disaster management cycle, which encompasses the stages of mitigation/ prevention, readiness, response, and recovery, is often the framework that predominates the literature (Coppola, 2011; Elboshy et al., 2019).

Figure 1. Defining Disaster (Khan and Khan, 2008)

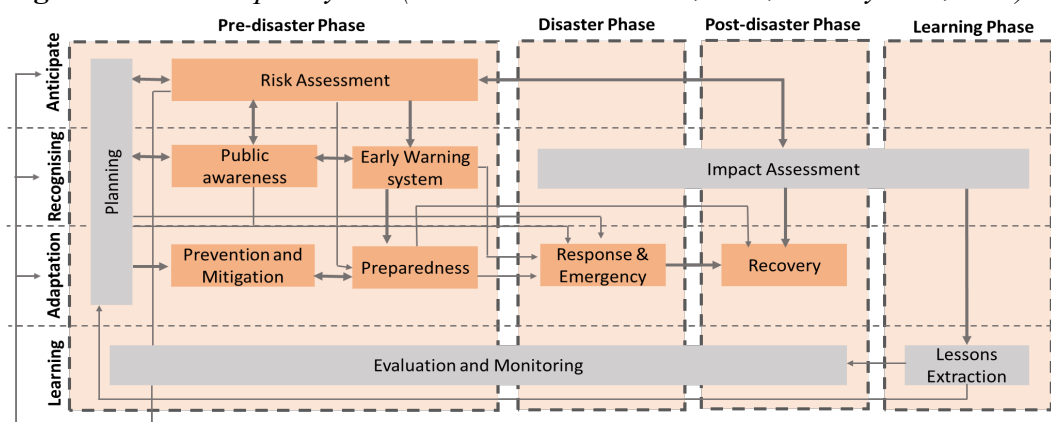


The increasing complexity and frequency of disasters, driven by various interacting factors, challenge the effectiveness of conventional scientific methods, requiring adaptable approaches that address complexity and uncertainty (Moore, 2008; GFDRR, 2016). This raises critical questions about whether current disaster risk management (DRM) policies and cycles remain adequate, or if new frameworks incorporating systems thinking and strategic approaches should be considered.

Disaster Risk Management Challenges

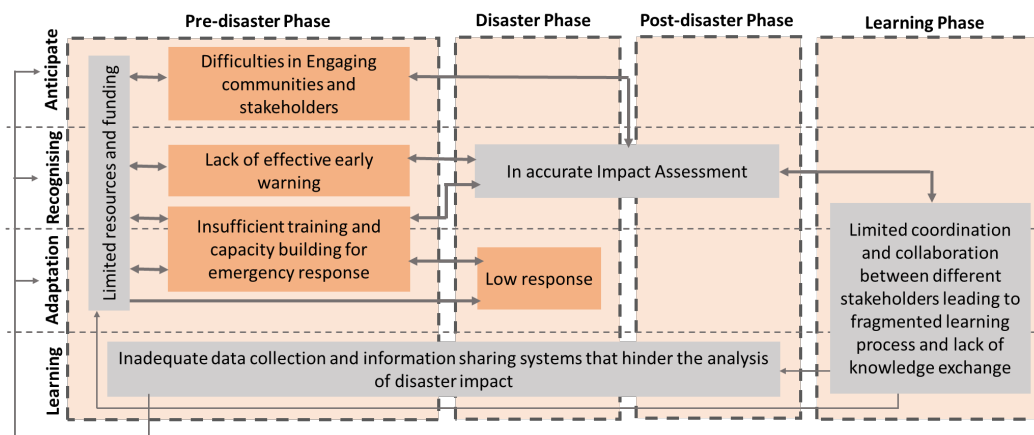
Disaster Risk Management (DRM) is a complex system requiring the integration of multi-sectoral and multidisciplinary planning and skills to mitigate the impact of disasters (NDMC, 2005). Despite the reliance on planning, issues arise from rigid procedures, outdated plans, and a segmented approach that often provides a false sense of security (Strelec, 2010; Moore & Lakha, 2006; Alexander, 2015). Plans are rarely updated and may not address diverse industry needs, leading to ineffective disaster management (Dynes, 1983). Figure 2 illustrates a DRM system, highlighting four key activities—anticipation, recognition, adaptation, and learning—across different disaster phases (Elboshy et al., 2019).

Figure 2. *DRM Complex System (Becker & Abrahamsson, 2012; Elboshy et al., 2019)*



The primary challenge in Disaster Risk Management (DRM) lies in the pre-disaster phase, particularly in planning and raising public awareness. Vulnerabilities such as population growth, lack of education, and institutional capacities are especially prevalent in developing regions. Despite awareness of risks, people are often drawn to hazardous areas due to job opportunities and access to essential services (Hallegatte, 2012; Patankar, 2015). Global trends indicate increased risk-taking, with populations in flood-prone and cyclone-prone areas growing significantly between 1970 and 2010 (Hallegatte et al., 2020). Effective DRM requires collaboration across institutions, reliable data, and a comprehensive legal framework (Ramos, 2009; Holden, 2013; UN, 2015). However, preparedness, a key element of DRM, faces criticism due to challenges in measuring readiness across different management levels and social structures (Castillo, 2005; Jackson, 2008; Fischbacher-Smith & Fischbacher-Smith, 2016). Figure 6 highlights the main challenges in translating DRM theory into practice, identifying gaps in each process.

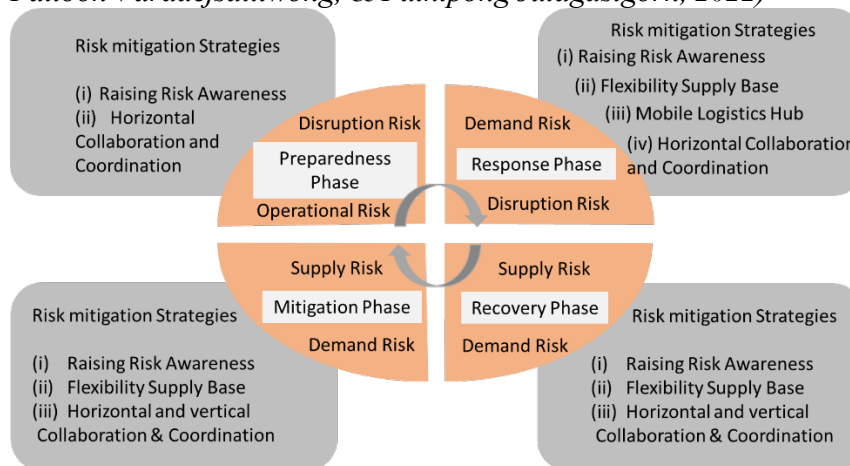
Figure 3. DRM Complex System Challenges (Researcher, 2023)



The response phase of disaster management faces significant challenges due to varying human reactions influenced by stress, chaotic conditions, and cultural factors. First responders often encounter unexpected, hostile situations, leading to potentially ineffective behavioral patterns (Weisaeth, 1989; Sawalha, 2018a, 2018b). Cultural characteristics also play a crucial role, with dysfunctional cultures more likely to fail in crisis situations (Pauchant & Mitroff, 1990).

Importance of Mitigation in the DRM

Figure 4. A Conceptual Framework identifying the Dominant Risks and Supply Chain Risk Mitigating Strategies in the DMC Phases. (Huay Ling Tay, Ruth Banomyong, Paitoon Varadejsatitwong, & Puthipong Julagasigorn, 2022)



Disaster mitigation involves actions to minimize the impact of disasters through preparedness and long-term risk reduction, including planning and developing response strategies for natural and human-induced hazards (Huay Ling Tay et al., 2022). The preparedness phase, crucial for effective disaster response, focuses on pre-disaster operations, ICT systems, and stakeholder collaboration in disaster management (Huay Ling Tay et al., 2022).

The Sendai Framework emphasizes disaster resilience, defining it as the ability of systems and communities to resist and recover from hazards through risk management (UN, 2015). Climate-resilient pathways require mitigation, adaptation, and flexible, context-specific strategies to manage climate impacts, considering interconnected regions and ongoing innovation (UN, 2015). Immediate action is vital for enhancing well-being, livelihoods, and environmental stewardship.

The Sendai Framework and its Indicators

The Sendai Framework, adopted in March 2015 as a successor to the Hyogo Framework for Action, is a 15-year, voluntary, and non-binding agreement aimed at reducing the frequency and severity of disasters globally. It outlines seven targets, including reducing disaster mortality, decreasing economic losses, and improving early warning systems by 2030. The framework emphasizes four key priorities: understanding disaster risk, strengthening governance, investing in resilience, and enhancing preparedness for effective response and recovery. It promotes a multi-sectoral and multi-stakeholder approach, aligning disaster risk reduction (DRR) with sustainable development and climate change adaptation, and encourages a shift from disaster management to proactive Disaster Risk Management (DRM), focusing on reducing vulnerabilities and strengthening resilience at both national and community levels (Nations, 2015).

The framework also highlights the importance of international cooperation, global partnerships, and the "Build Back Better" principle in disaster recovery. It includes a set of indicators to measure progress in achieving its goals, which cover various aspects of disaster risk, vulnerability, and resilience. These indicators serve as tools for countries and organizations to develop, implement, and assess the effectiveness of DRR strategies. By providing a comprehensive set of criteria and priorities, the Sendai Framework guides the evaluation of DRR policies, ensuring that objectives are clear, specific, and aligned with the overarching goals of flood risk reduction and resilience (Omar Bello, et al., 2021).

Table 1. Sendai Framework and Indicators (Nations, 2015)

Criteria	Description
Understanding Disaster Risk	Policies should demonstrate a clear understanding of local, national, and regional disaster risks. This includes the identification and assessment of hazards, vulnerabilities, and exposure to risks.
Governance and Leadership	Effective policies should promote strong governance and leadership at all levels, emphasising the involvement of relevant stakeholders, including communities, in decision-making processes.
Investment in DRR	Policies should allocate resources and investments to support DRR activities, infrastructure development, and capacity-building efforts.
DRR Strategies	Policies should align with and contribute to the development and implementation of DRR strategies and plans, ensuring they are integrated into wider development agendas.
Resilience of Infrastructure and Critical Facilities	Policies should prioritise the resilience of critical infrastructure, such as hospitals, schools, and utilities, to ensure they can withstand and recover from disasters.
Community Engagement	Policies should promote community participation, empowerment, and awareness-building to enhance local resilience and adaptive capacity.
Early Warning Systems	Policies should support the establishment and maintenance of effective early warning systems to provide timely information and alerts to at-risk communities.
Climate Change Adaptation	Policies should integrate climate change adaptation measures into DRR strategies, recognising the interconnection between climate change and increased disaster risks
Reducing Environmental Degradation	Policies should aim to reduce environmental degradation and promote sustainable land use practices to mitigate disaster risks.
Monitoring and Reporting	Policies should establish robust monitoring and reporting mechanisms to track progress in DRR efforts and adapt strategies as needed.
International Cooperation	Policies should encourage international cooperation and collaboration to address transboundary disaster risks and promote the exchange of knowledge and resources.
Public Awareness and Education	Policies should promote public awareness and education campaigns to enhance understanding of disaster risks and encourage proactive risk reduction actions.
Knowledge and Innovation	Policies should support research, innovation, and the dissemination of knowledge and best practices related to DRR.
Accountability and Review	Policies should establish mechanisms for accountability and regular review of progress in implementing DRR measures.

Methodology

This study aims to examine the measures taken by the Egyptian government to boost resilience during the flooding mitigation through the implementation set of objectives leads to strategies on the national level and local levels.

Based on the understanding of the disaster risk management criteria and cycle through 1970 to 2030 as a base to investigate the disaster risk management challenges and highlight the importance of the mitigation stage as part of the disaster risk management and how it can be reflected on the disaster risk cycle, incorporating the synthesis of a set of Disaster Risk Reduction (DRR) indicators based on the Sendai framework. Comprising its four main priorities, the proposed framework involves an examination of the DRM situation, an assessment of DRM elements, the evaluation of efficiency criteria, and the integration of results from each stage to furnish a comprehensive analysis of the DRM system.

In the initial step, understanding for the flood disaster in Egypt and how the institutional framework and practices employed in previous disasters are scrutinised to enhance understanding of the national Disaster risk management landscape. This phase identifies the entities involved in DRM, delineates their roles, and assesses how the existing system has responded to disasters across various phases. Data are collected from governmental documents and reports to facilitate a comprehensive analysis.

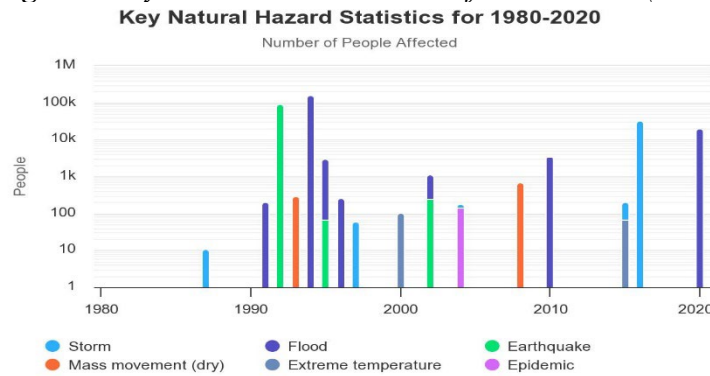
The second step concentrates on the assessment of efficiency criteria derived from the compiled list of indicators. Subsequently, findings from all stages are amalgamated, presenting a holistic analysis of the Egyptian Crisis and Disaster management and risk reduction system. This comprehensive evaluation identifies key issues impacting system performance and highlights impediments to its enhancement.

To demonstrate the applicability of the proposed framework, an evaluation of the Egyptian DRM system is conducted, yielding valuable insights into its strengths and weaknesses. This framework serves as a foundational tool for evaluating DRR systems in diverse countries, contributing to the formulation of more effective DRM strategies and policies.

Flooding in Egypt

Egypt, located in northeastern Africa, spans 995,450 square kilometers and has a 3,500-kilometer coastline along the Mediterranean and Red Seas, making its extensive coastal areas vulnerable to rising sea levels due to their low elevation (Abdeldayem et al., 2020; Egyptian Environmental Affairs Agency, 2016). Major cities in the Delta region, such as Alexandria and Port Said, host significant industrial, tourism, and agricultural activities, making them particularly at risk (Ali & El-Magd, 2016). Historically, Egypt has faced flooding since ancient times, with the Nile's annual inundation bringing fertility to farmlands, but in modern times, floods have caused severe damage to infrastructure and communities. The 2020 floods, which affected over 10,000 people, led to government emergency responses and efforts to enhance flood management systems (Ahmed et al., 2020).

Figure 5. Key Natural Hazard Statistics for 1980-2020 (The World Bank Group, 2021)

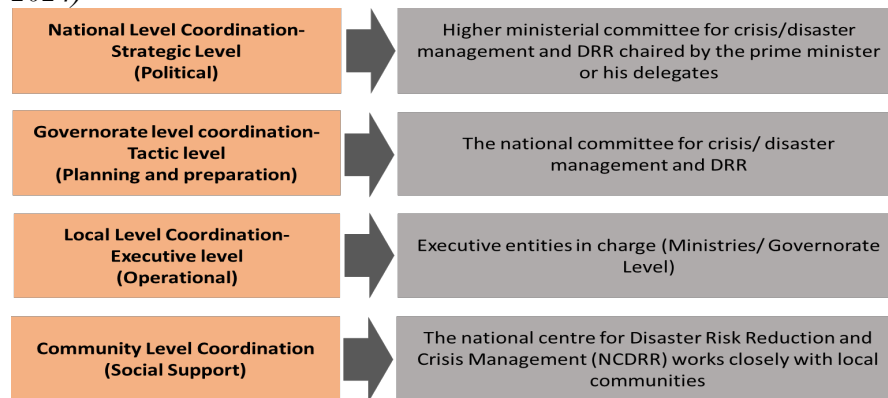


Investing in the Egyptian Flood Mitigation Policy

Egypt has a comprehensive disaster management system that includes different levels of coordination and risk reduction efforts. The levels of disaster management and DRR coordination in Egypt are as follows (Figure 6):

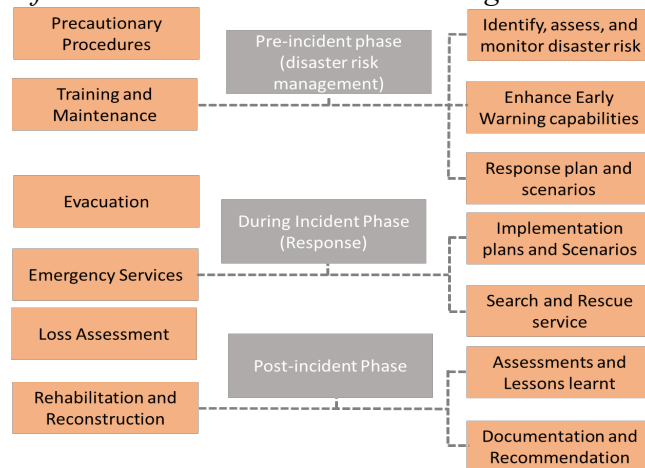
- a) **National level coordination:** The National Disaster Management Authority (NDMA) is responsible for the overall coordination of disaster management in Egypt. The NDMA is responsible for developing and implementing national policies, strategies, and plans related to disaster management. It also coordinates with other government agencies, NGOs, and international organisations to respond to disasters and mitigate their impacts. (United Nations Development Programme. (2018).
- b) **Governorate-level coordination:** The governorates are responsible for implementing the national disaster management policies, strategies, and plans in their respective regions. Each governorate has a disaster management committee that is responsible for disaster preparedness, response, and recovery. The committee is composed of representatives from different government agencies, NGOs, and the private sector.
- c) **Local level coordination:** The local authorities, such as municipalities and local councils, are responsible for disaster preparedness, response, and recovery in their respective areas. They work closely with the governorate disaster management committee and other stakeholders to ensure a coordinated and effective response to disasters.
- d) **Community-level coordination:** Community participation and involvement are essential for effective DRR. The community plays a crucial role in disaster preparedness, response, and recovery. The National Centre for DRR and Crisis Management (NCDRR) works closely with local communities to raise awareness about disaster risks and promote disaster preparedness (Egypt, 2005)

Figure 6. *Levels of Crisis/disaster Management and DRR Coordination (researcher, 2024)*



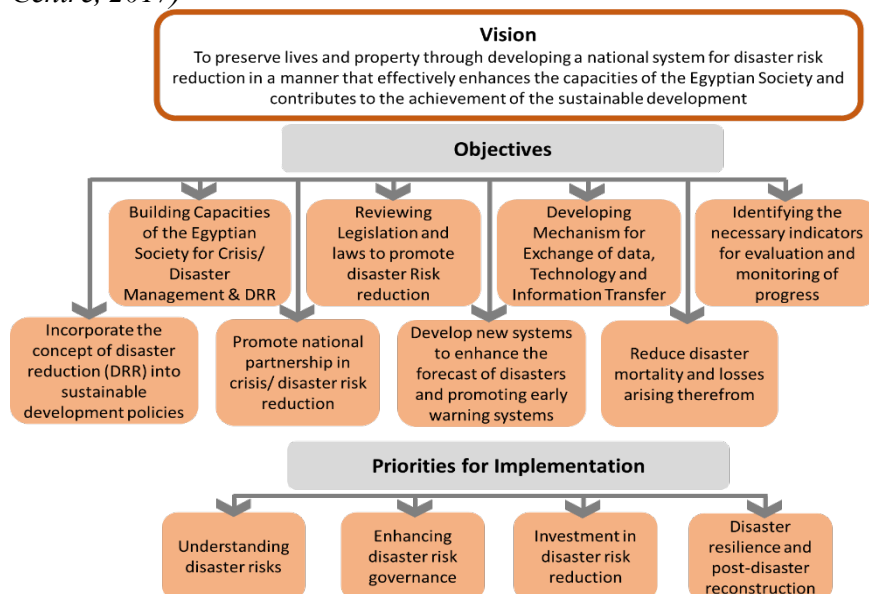
The committee's main goal is to reduce the impact of disasters through collaboration between government institutions, civil society, and the private sector. They aim to strengthen national mechanisms and capacities to enhance resilience and address future risks.

Figure 7. *The Three Phases of Crisis and Disaster Management (The Cabinet of Egypt Information and Decision S-Crisis Management and DRR Sector Support Centre, 2017)*



The committee's objectives include developing national policies for crisis and disaster management, enhancing technical and scientific capabilities to assess vulnerabilities, using advanced technology for crisis management, fostering expert cooperation, and implementing a national program to inform citizens about disaster risks. Their tasks span three phases: pre-crisis (preparedness and risk reduction), crisis management and response, and post-crisis recovery. In line with regional and international commitments, Egypt introduced the NSDRR 2030 to strengthen its disaster risk reduction framework. The vision of NSDRR 2030 is to "preserve lives and property by developing a national system for DRR that enhances national capabilities and contributes to sustainable development" (The Cabinet of Egypt Information and Decision Support Centre, 2017).

Figure 8. Overall Summary of the National Strategy for DRR 2030 (The Cabinet of Egypt Information and Decision S- Crisis Management and DRR Sector Support Centre, 2017)



To effectively execute the NSDRR 2030 and achieve its objectives, Egypt must undertake a series of defined actions that not only mitigate disaster risks but also align with international obligations and regional contexts. The implementation of these actions is guided by a handbook outlining the roles and responsibilities of various entities in crisis and disaster management. These implementation methods encompass a range of national plans developed to address Egypt's recent crises and tragedies. The following evaluation suggested projects in Figure 13 are prioritised based on their implementation timeline: short-term (two years), medium-term (five years), and long-term (ten years). Each responsible entity is required to provide a comprehensive identification and description of their specific responsibilities, as outlined in Table 2.

Table 2. The Egyptian Crisis and Disaster Management and Risk Reduction Initiative (ECIDSC, 2010)

Objective one: Concept of Crisis			
Including crisis/disaster management and disaster risk reduction in all development policies and plans. It consists of poverty reduction techniques and sectors and multi-sectoral policies and initiatives.			
Short-term stage (two years)			
Objective 2: Building the Egyptian Society			
Supporting the establishment and strengthening of an integrated national mechanism for DRR that is responsible at all local and national levels for facilitating the cross-sector coordination	Adopting legislation to support DRR, including systems and mechanisms to encourage compliance and enhance mitigation activities.	Assessing the capacities of human resources to reduce disaster risks at all levels, while developing plans and programs.	Identifying clear priorities and budgets for resource allocation to design and implement DRR policies, programs, and regulations.
Short-term stage (two years)	Medium-term stage (five years)		Short-term stage (two years)

Objective 3: Volunteerism and Community Participation			
Increasing public understanding: -Improving the role of the media in persuading society to embrace a disaster-resilient culture.	-Protecting and improving infrastructures and rebuilding so that they are suitably resilient to threats. -Incorporating DRR measures into the post-disaster recovery process. -Establishing a structure for financial risk-sharing, particularly risk insurance and reinsurance.	-Incorporating disaster risk assessment in urban planning and management areas of high population density and rapid urbanization. -In the context of urban poverty reduction and poor district improvement programs, informal or temporary housing must be addressed alongside high-risk housing areas. -In the framework of land use and planning, developing, completing, and supporting the implementation of general guidelines and monitoring instruments for disaster risks.	-Introduce specialized ways to encourage stakeholders, including local communities, to successfully participate in and control DRR operations, particularly volunteerism. Local communities should work on adopting policies, improving network development, strategic management of volunteer resources, assigning roles and responsibilities, and delegating and providing appropriate authorities and resources.
Short-term stage (two years)	Medium-term stage (five years)		

Objective 4: Developing mechanisms for data required in crisis management	
-Improving projection-based risk assessments, Cost analysis of risk reduction measures at all levels, and incorporating such approaches into the decision-making process at the local and national levels. -Introducing and applying methods through scientific experts, research, and models to assess vulnerable areas and the impact of hazards related to geography, meteorology, water, and climate, as well as regional monitoring and assessment capacities.	Creating and updating risk maps and ensuring timely and appropriate distribution of essential information to decision-makers and vulnerable communities on a large scale. -Recording, evaluating, summarizing, and disseminating statistical data on risk frequency, impact, and losses regularly.
Medium-term stage (five years) ++	Short-term stage (two years) +

Objective 5: Enhancing existing Early warning systems			
Early alert: -Building institutional capacities that would ensure sound incorporation of the early warning systems in government policies and emergency management systems at the national and local levels. These systems should be tested, and their performance evaluated regularly.	Capacity: -Supporting the introduction and the sustainability of basic structures, and scientific, technological, technical, and institutional capacities required for research, monitoring, analysis and forecasting natural and other relevant risks, vulnerable areas, and disaster impacts.	Regional and emerging risks: -Collecting and unifying the statistical information and data related to disaster risks, impacts, and consequences at the regional level. -Cooperating regionally and internationally to assess and survey regional or cross-border risks, exchanging information, and making available early warning via the appropriate measures.	Information management and exchange: -Enhancing the use, application and availability of ICT and the related services to support disaster risk reduction, especially for training and information exchange and dissemination on the various beneficiaries. -Before each building project or land purchase or sale, urban development institutions shall provide information on DRR choices.
Long-term stage (ten years) +++	Medium-term stage (five years) ++	Short-term stage (two years) +	Short-term stage (two years) +



Objective six: Identifying the indicators for follow-up monitoring
There are indicators for implementing a crisis/disaster management and disaster risk reduction program.
Short-term stage (two years) +

The contiguity of Egyptian crisis and disaster management alongside the Sendai Indicators constitutes a pivotal examination of two separate yet interrelated strategies for disaster preparedness and risk mitigation. The Egyptian crisis and disaster management initiative is deeply rooted in the distinctive socio-economic and environmental challenges as discussed in Table 2. This initiative encompasses a comprehensive plan aimed at reducing risks, bolstering response capabilities, and nurturing resilience within the specific context of Egypt. Conversely, the Sendai Indicators, introduced as a global framework after the 2015 Sendai Framework for DRR, furnish a set of criteria and guidelines for evaluating worldwide DRR endeavours. Through the comparative analysis of these two approaches, we glean valuable insights into the adaptability and efficacy of disaster management methodologies across diverse settings, as well as the harmonisation of domestic initiatives with international benchmarks. Such an investigation will illuminate the strengths and weaknesses inherent in both approaches, fostering a more comprehensive comprehension of global DRR efforts.

Despite Egypt's adoption of the Sendai Framework for DRR, the implementation has faced challenges in unpacking and fully realising the magnitude of the situation within the country. The limitations and scarcity of resources in various areas have hindered the effective execution of the framework. Despite the commitment to DRR, the practical application has been impeded by these constraints, underscoring the need for targeted efforts and resource allocation to address the specific challenges faced by Egypt in enhancing its resilience to disasters. Comparing the Sendai Indicators to the Egyptian crisis and DRM initiative, there are several areas of alignment and adaptation. The Sendai Indicator 1, which focuses on understanding disasters, corresponds to the Egyptian initiative's Objective 1, emphasising the concept of crisis. Indicator 2, Governance and Leadership, relates to the Egyptian initiative's Objective 5, which aims to enhance existing early warning systems. Indicator 3, Investment in DRR, aligns with Objective 3 of the Egyptian initiative, emphasising volunteerism and community participation. Indicator 4, DRR Strategies, is mirrored in Objective 4, where the Egyptian initiative seeks to develop mechanisms for data required in crisis management. However, several Sendai indicators do not have direct counterparts in the Egyptian crisis and disaster management initiative, such as Indicator 5 (Resilience of Infrastructure and Critical Facilities), Indicator 12 (Public Awareness and Education), Indicator 13 (Knowledge and Innovation), and Indicator 14 (Accountability and Review). The Egyptian government's efforts in the mitigation preparedness phase of the Disaster Risk Management (DRM) cycle have encountered notable shortcomings. These deficiencies stem from a range of factors, including resource limitations, inadequate infrastructure, and challenges in effectively implementing comprehensive and proactive strategies. The mitigation preparedness phase, crucial for minimising the impact of disasters, requires enhanced attention

and strategic planning to address vulnerabilities effectively. Recognising and addressing these shortcomings is essential for improving the overall resilience of the nation in the face of potential hazards and disasters. It also highlights areas where the Egyptian initiative can potentially benefit from further integration of these Sendai indicators to enhance its overall effectiveness in addressing disaster management and risk reduction.

Results and Recommendations

Egypt has implemented various flood mitigation strategies, including early warning systems, green infrastructure, and comprehensive land-use planning, to enhance community resilience against floods. The effectiveness of these measures, however, requires thorough assessment to determine their impact on reducing flood risks and bolstering community preparedness. Evaluating early warning systems involves assessing the accuracy, reliability, and community response to the information provided. The integration and impact of green infrastructure, such as wetlands and green roofs, in the overall flood management strategy also need to be examined. Additionally, the role of land-use planning policies in guiding development away from flood-prone areas and preparing communities for flood impacts must be evaluated. These evaluations are crucial for refining Egypt's flood mitigation strategies and ensuring that communities are better equipped to handle future flood events. Addressing these gaps in the current flood mitigation strategies in Egypt is essential in order to build a more resilient future and better prepare communities for the impacts of floods. Through evaluating of the flood mitigation strategies, the following gaps can be highlighted:

- a) **Inadequate investment in early warning systems:** While early warning systems are an important part of the flood mitigation strategy in Egypt, they are not always well-funded and lack the resources needed to be effective. This can result in a lack of accurate and timely information for communities, making it difficult for them to prepare for and respond to floods.
 - **Resource Constraints:** Limited financial resources may pose a significant challenge to investing in comprehensive early warning systems. Budgetary constraints may prioritise other sectors over the development and maintenance of advanced warning infrastructure.
 - **Competing Priorities:** Egypt may face competing priorities for investment, with pressing needs in areas such as healthcare, education, and infrastructure development. Early warning systems might not receive sufficient attention in resource allocation decisions.
 - **Perceived Low Risk:** If certain regions of Egypt are perceived as having a low risk of specific types of disasters, there may be a tendency to underestimate the importance of investing in early warning systems. This perception can lead to a lack of prioritisation.
 - **Limited Technical Capacity:** Developing and maintaining effective early warning systems requires technical expertise and ongoing training.

If there is a lack of skilled personnel and technical capacity, it can hinder the implementation and optimisation of warning systems.

- **Infrastructure Challenges:** Inadequate physical infrastructure, such as communication networks and meteorological stations, may impede the establishment and functionality of early warning systems. The lack of infrastructure can result in gaps in coverage and reliability.
 - **Data Collection and Analysis Issues:** Insufficient data collection and analysis capabilities can impact the effectiveness of early warning systems. Accurate and timely data are crucial for issuing timely warnings, and limitations in this regard can compromise the system's reliability.
- b) **Ineffective implementation of comprehensive land-use planning policies:** Comprehensive land-use planning policies play a crucial role in reducing the risk of flooding by ensuring that development takes place in areas that are less prone to flooding. However, in Egypt, these policies are often not effectively implemented, resulting in continued development in areas that are at high risk of flooding.
- c) **Limited community engagement and participation:** Building resilience to floods requires the engagement and participation of all stakeholders, including communities. However, in Egypt, there is often a lack of community engagement and participation in the planning and implementation of flood mitigation strategies, limiting their effectiveness in building resilience. Several factors contribute to limited community engagement and participation in disaster risk management (DRM) in Egypt:
- **Top-Down Approach:** Historically, disaster management in Egypt has often followed a top-down approach, where decisions and strategies are formulated at higher levels of government without sufficient input from local communities. This may result in a lack of ownership and understanding at the community level.
 - **Communication Barriers:** Challenges in effective communication and information dissemination can hinder community participation. Limited access to information, especially in rural areas, may prevent communities from being aware of the importance of their involvement in DRM.
 - **Cultural and Social Factors:** Cultural norms and social structures can influence community engagement. In some cases, hierarchical structures or cultural norms may discourage active participation or input from community members in decision-making processes.
 - **Limited Resources:** Communities, particularly in rural areas, may face economic challenges and lack the resources needed to actively engage in disaster risk reduction initiatives. This includes financial resources, infrastructure, and access to education and training.
 - **Perceived Lack of Influence:** Communities may perceive that their input has limited influence on decision-making processes. This perception can arise if there is a history of decisions being made without community consultation or if there is a lack of mechanisms for feedback and dialogue.

- **Educational Gaps:** Limited awareness and understanding of disaster risks and the importance of community engagement may exist. Educational gaps in disaster preparedness and risk reduction strategies can hinder the active involvement of communities.
 - **Institutional Barriers:** Formal institutions and bureaucratic processes may create barriers that limit the direct involvement of communities in DRM. Streamlining institutional processes and creating mechanisms for community participation can address this challenge.
 - **Emergency Response Focus:** The emphasis on emergency response rather than long-term risk reduction in disaster management initiatives may contribute to communities perceiving their role as reactive rather than proactive, reducing their motivation to engage.
- d) Building resilience to floods in Egypt faces challenges due to a lack of coordination between government agencies, private sector organizations, and communities, leading to fragmented flood management efforts. The National Committee for Crisis/Disaster Management and DRR, chaired by the Prime Minister and including key ministries, oversees national crisis management at a strategic level. However, operational responses are decentralized, and fragmented coordination can hinder a unified approach, particularly in early warning systems. Egypt's national strategy aligns with the International Sendai Framework for Disaster Reduction 2015–2030, emphasizing disaster risk governance, risk reduction, resilience building, and post-disaster reconstruction. Effective collaboration among stakeholders is crucial for a coherent and efficient disaster management system.

Conclusion

In summary, this study has thoroughly examined Egypt's flood mitigation efforts and their role in fostering resilience. Beginning with an exploration of the disaster risk management (DRM) concept, the paper underscored the necessity for contemporary disaster management approaches, emphasising the shift from reactive to proactive and holistic strategies. The distinction between mitigation and resilience was elucidated, highlighting the evolution towards building community capacity to withstand and recover from disasters, representing a paradigm shift in disaster management. The evaluation criteria were outlined to assess the efficacy of Egypt's flood mitigation policy in enhancing resilience. The analysis, focused on the historical context of flooding in Egypt, illuminated the transformation of Egyptian DRM over time and provided insights into challenges and the importance of adaptive strategies. The assessment of Egypt's flood mitigation policy revealed commendable strengths alongside areas for improvement. While significant strides have been made in mitigating flood impacts, the study underscores the necessity for a comprehensive and integrated approach, encompassing various aspects of resilience such as early warning systems, infrastructure development, community engagement, and capacity building. Overall, the findings underscore the significance of continual evaluation and adaptation of disaster risk reduction policies in the face of evolving climatic and

socio-economic conditions. Integrating resilience-building measures into flood mitigation policies can fortify Egypt's ability to withstand future flood events and mitigate socio-economic and environmental impacts. Achieving resilience necessitates a multi-stakeholder approach involving collaboration between government agencies, local communities, and international partners. Through concerted efforts and an unwavering commitment to improvement, Egypt can enhance its flood mitigation strategies and move towards a more resilient future.

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