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Beirut's Port Explosion: a Case of Disaster Response and Recovery

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The explosion at the Port of Beirut on August 4, 2020, was one of the most severe non-nuclear blasts ever recorded, causing extensive destruction and exacerbating Lebanon's ongoing political and economic crisis. This paper examines the systemic deficiencies that contributed to the disaster, with a particular focus on inadequate regulatory oversight and the absence of a comprehensive disaster management plan. The response was marked by governmental inaction and political instability, which significantly hindered recovery efforts and delayed aid distribution, further eroding public trust in state institutions. In contrast, community-led initiatives and non-governmental organizations played a pivotal role in providing immediate assistance, demonstrating the resilience of local populations in the absence of a coordinated reconstruction strategy. This paper analyzes the systemic failures that contributed to the Beirut Port explosion and discusses the broader implications for governance, urban resilience, and disaster risk management in politically and economically fragile states. This findings highlight the urgent need for governance reforms and transparent crisis management frameworks to enhance resilience and mitigate the risk of future catastrophes.

Keywords: disaster management, urban resilience, Beirut port explosion, disaster response, recovery.

1. Introduction

The ability of communities to withstand and recover from disasters is a critical determinant of their overall well-being. Previous research has highlighted that effective response and recovery efforts are closely linked to the robustness of social networks and adaptive governance mechanisms. Given the complex nature of disaster response, it is important to analyze different case studies to examine how different governance structures and societal frameworks influence recovery trajectories.

On August 4, 2020, the Beirut Port explosion resulted in one of the most significant non-nuclear blasts in history, caused by the detonation of 2,750 tons of improperly stored ammonium nitrate. The explosion produced a shockwave equivalent to a magnitude 3.3 earthquake, leading to extensive devastation across Beirut and causing widespread destruction (Yu et al., 2021). The disaster led to over 200 fatalities, approximately 6,500 injuries, and severe infrastructural damage, displacing more than 300,000 residents. Entire neighborhoods were reduced to rubble, and critical infrastructure, including hospitals, schools, and government buildings, sustained significant damage (Sadek et al., 2022).This disaster serves as a critical case study in urban resilience and disaster risk management.

This paper seeks to provide a comprehensive assessment of disaster management successes and failures in the context of a politically and economically fragile state. The analysis examines the deficiencies in disaster preparedness, the short- and long-term consequences of the disaster, and lessons that may inform strategies for enhancing urban resilience. The findings contribute to broader discussions on emergency planning in urban environments vulnerable to human-induced disasters.

2. Pre-Disaster Context

2.1. *Absence of Disaster Management Plans*

Despite Lebanon's history of political instability and exposure to environmental risks, no comprehensive disaster management strategy was in place prior to the explosion (Malak et al., 2021). Evidence indicates that authorities did not implement adequate measures to mitigate the risks associated

with hazardous material storage. Over the years, multiple warnings concerning the presence of ammonium nitrate at the port were ignored, highlighting systemic deficiency in risk assessment and crisis preparation (Sivaraman and Varadharajan, 2021).

Lebanon's disaster preparedness approach was largely reactive rather than proactive, relying on emergency responses rather than preventive risk reduction strategies. The absence of emergency response plans resulted in institutions being ill-equipped to manage large-scale disasters (Tawil et al., 2023). Furthermore, the lack of standardized operating procedures (SOPs) for hazardous material management exacerbated the crisis, leading to disorganized and ineffective responses during the explosion.

In addition, Lebanon lacked an institutionalized disaster risk reduction (DRR) framework, and no dedicated authority was responsible for overseeing disaster preparedness efforts. Unlike countries with well-established emergency response frameworks, Lebanon's disaster management system relied on ad-hoc crisis response mechanisms, which were characterized by limited coordination between government agencies and civil society actors.

2.2. *Infrastructure and Regulatory Deficiencies*

The explosion emphasized the vulnerabilities of Beirut's aging infrastructure and the weak regulatory enforcement mechanisms (Sadek et al., 2022). The port, which represents a critical trade hub, had been left exposed to risk due to prolonged neglect and inadequate safety measures. Decades of underinvestment and mismanagement in Lebanon's infrastructure sector contributed to the deterioration of essential facilities, including port storage warehouses and transportation networks (Aouad and Kaloustian, 2021).

Moreover, hazardous materials were stored without clear regulatory oversight, as government agencies failed to enforce compliance with safety protocols (Malak et al., 2021). Investigations revealed that multiple government departments had been aware of the presence of ammonium nitrate for several years but had taken no preventative action. The absence of a clearly defined jurisdiction among regulatory bodies further compounded the issue, creating delays in intervention and risk mitigation efforts (Ismail et al., 2021).

The failure to conduct routine risk assessments and enforce structural integrity standards significantly increased the scale of destruction (Jahami et al., 2023). Urban planning experts argue that the outdated design and construction of Beirut's port facilities made them highly susceptible to the shockwave generated by the explosion. Had preventive measures been in place, the extent of the damage could have been considerably reduced.

2.3. *Socioeconomic and Political Vulnerabilities*

At the time of the explosion, Lebanon was already experiencing severe economic decline and social unrest (Geha et al., 2020). These pre-existing vulnerabilities greatly hindered the country's ability to respond effectively to the disaster.

Lebanon's economic crisis, which had been ongoing since 2019, had significantly weakened state institutions and reduced the government's capacity to finance emergency responses. Hyperinflation, widespread unemployment, and a failing banking sector had already placed considerable strain on Lebanese citizens before the explosion occurred (Issa et al., 2023). The government's inability to provide financial assistance or essential resources in the aftermath of the disaster further exacerbated the crisis, leading to widespread public dissatisfaction and mass protests.

Systemic governance failures and widespread corruption further undermined coordinated disaster risk management efforts. Lebanon's political system, which is characterized by sectarian divisions and elite dominance, has historically resulted in fragmented governance and ineffective policy implementation (Geha et al., 2020). Consequently, disaster preparedness and emergency response mechanisms remained underdeveloped, as political leaders prioritized self-preservation over national security concerns.

Furthermore, Lebanon's ongoing refugee crisis placed additional pressure on its already strained

emergency response systems. The country hosted over 1.5 million refugees, many of whom reside in overcrowded and underdeveloped areas. The lack of adequate infrastructure and essential services in these communities exacerbated the humanitarian impact of the explosion, leaving marginalized populations particularly vulnerable (Broomandi et al., 2021).

3. The Explosion and Immediate Aftermath

3.1. *Timeline and Cause of the Explosion*

Investigations confirmed that the explosion was caused by the prolonged and unsafe storage of ammonium nitrate at the port's warehouse (Yu et al., 2021). The 2,750 tons of ammonium nitrate, originally confiscated from a vessel in 2013, had been stored under hazardous conditions, lacking proper oversight, ventilation, and security measures (Sivaraman and Varadharajan, 2021).

The precise cause of ignition remains a subject of debate. However, prevailing theories suggest that welding operations near the warehouse may have triggered the detonation by igniting nearby combustible materials. Reports indicate that multiple government agencies had been aware of the risks associated with the stored chemicals but had failed to take preventive action to remove or secure them (Malak et al., 2021). The explosion generated a blast wave estimated to be equivalent to 1.1 kilotons of TNT, with the shockwave being heard as far as Cyprus, over 250 kilometers away (Sadek et al., 2022).

The force of the explosion caused widespread destruction, leaving a crater approximately 43 meters deep and 140 meters wide in the port area (Jahami et al., 2023). Entire districts were devastated, with severe structural damage extending several kilometers from the blast site.

3.2. *Initial Impact: Casualties and Infrastructure Damage*

The explosion resulted in catastrophic damage, particularly in central Beirut, with the port area being almost entirely destroyed. Key consequences included:

- Over 200 fatalities and approximately 6,500 injuries, placing an immense strain on medical facilities (Ismail et al., 2021).
- The displacement of more than 300,000 residents, particularly in severely affected neighborhoods such as Mar Mikhael, Gemmayze, and Karantina, according to the Beirut Urban Lab.
- Estimated economic losses of $15 billion, further destabilizing Lebanon's already fragile economy (Sadek et al., 2022) .
- The destruction of Beirut's grain silos, which stored approximately 85% of the country's grain reserves, thereby exacerbating food insecurity (Ismail et al., 2021).

The blast wave caused damage to buildings up to 10 kilometers from the explosion site, shattering windows, overturning vehicles, and leaving extensive destruction across the city (Jahami et al., 2023).

Emergency services were quickly overwhelmed, as hospitals were already operating under strained conditions due to the ongoing COVID-19 pandemic. Some of the largest medical facilities, including Saint George Hospital and the Lebanese Hospital Geitaoui, sustained severe structural damage, further reducing Beirut's medical capacity at a critical moment (Al-Hajj et al., 2021). The immediate shortage of medical supplies, blood donations, and intensive care units hindered the emergency response, requiring extensive support from international humanitarian organizations.

3.3. *Psychological Effects*

The psychological impact of the explosion was profound, with widespread trauma affecting survivors, first responders, and the broader population. Key mental health consequences included:

- Increased prevalence of post-traumatic stress disorder (PTSD), anxiety, and depression, particularly among children and emergency personnel (Charara and El-Khoury, 2021).
- Reports of sleep disturbances, intrusive memories, and increased stress responses, especially among residents in the most severely impacted

districts (Medawar et al., 2021).
- A significant erosion of public trust in government institutions, as many perceived the state's response as inadequate and ineffective (Geha et al., 2020).

Mental health services were quickly overwhelmed, with numerous non-governmental organizations (NGOs) stepping in to provide psychological support and crisis counseling. However, access to mental health care remained limited, particularly for marginalized communities and refugees (Issa et al., 2023).

The long-term psychological consequences of the explosion continue to affect thousands of individuals, many of whom struggle with untreated trauma and unresolved grief. The absence of a structured national mental health response highlights the ongoing need for sustained psychosocial support and community-based resilience programs.

4. Emergency Response

4.1. *Community-Led Grassroots Response*

In the immediate aftermath of the explosion, Beirut's residents became the first responders, initiating efforts to assist victims, provide medical aid, and clear debris. According to the Beirut Urban Lab, local volunteers rapidly organized search and rescue operations, extracting survivors from the rubble and administering first aid before emergency services arrived.

Community members, including those injured in the blast, mobilized to support overwhelmed hospitals by donating blood, establishing makeshift medical stations, and offering temporary shelter to displaced individuals. The absence of a coordinated government-led response during the critical initial hours resulted in a heavy reliance on informal networks. Local businesses and religious organizations played a central role in coordinating aid distribution and providing essential supplies (Sadek et al., 2022).

Social media platforms were instrumental in facilitating relief efforts. These platforms enabled volunteers to broadcast urgent needs, direct medical assistance to affected areas, and organize cleanup operations in devastated neighborhoods, including Mar Mikhael, Gemmayze, and Karantina.

4.2. *Role of NGOs and International Organizations*

As the government response remained ineffective, non-governmental organizations (NGOs) and international agencies played a pivotal role in delivering emergency assistance. The Lebanese Red Cross and Médecins Sans Frontières (Doctors Without Borders) were among the first organizations to establish emergency medical tents, treating thousands of injured residents amid hospital closures and capacity shortages (Al-Hajj et al., 2021).

At the international level, the United Nations and the European Union provided substantial financial and logistical support to facilitate relief efforts. However, due to concerns over government corruption, many international donors chose to channel funds directly to NGOs and grassroots organizations rather than through state institutions.

A critical component of the NGO response was mental health support. Given the widespread psychological trauma following the explosion, organizations such as Embrace Lebanon and the Restart Center established crisis counseling services, offering free psychological support to individuals experiencing post-traumatic stress disorder (PTSD), anxiety, and depression (Charara and El-Khoury, 2021).

4.3. *Governmental Response and Limitations*

The Lebanese government's response to the explosion was widely criticized for being delayed, insufficient, and poorly coordinated, further increasing public distrust in state institutions (Daia and Yaacoub, 2021). Key shortcomings of the government's handling of the crisis included:

- Delayed emergency response – Despite the severity of the disaster, there was no immediate state-led coordination of relief efforts, leaving many survivors without assistance for several hours.

- Lack of communication and transparency – Authorities failed to provide timely and accurate information regarding casualty figures, relief operations, and international aid efforts, contributing to public confusion and distrust.
- Weak logistical coordination – Bureaucratic inefficiencies led to delays in processing international aid shipments, preventing life-saving supplies from reaching affected communities in a timely manner (Malak et al., 2021).

Following the explosion, the government declared a state of emergency, transferring crisis management responsibilities to the Lebanese Army. However, military efforts were primarily focused on security enforcement and damage assessment rather than direct relief operations (Sadek et al., 2022). Although financial compensation was promised to affected families, bureaucratic obstacles and allegations of corruption hindered the effective distribution of funds.

As a consequence of widespread public anger and mounting pressure, the Lebanese cabinet resigned one week after the explosion. However, long-term accountability remains limited, as no senior officials have been held legally responsible for their role in the disaster (Geha et al., 2020).

5. Challenges in Recovery and Reconstruction

5.1. *Economic and Political Instability*

Prior to the explosion, Lebanon was already experiencing severe economic and political instability. The country faced hyperinflation, a banking system collapse, and rising unemployment, all of which significantly hindered resource allocation for recovery efforts (Geha et al., 2020).

Several economic challenges further impeded reconstruction, including:

- Currency devaluation – The Lebanese pound lost over 90% of its value between 2019 and 2021, making reconstruction costs unsustainable.
- Banking sector collapse – Severe restrictions on withdrawals prevented individuals and businesses from financing repairs and rebuilding efforts.
- Rising unemployment – The explosion further increased job losses, particularly in the hospitality, retail, and service sectors, which were heavily concentrated in the affected districts.

The political situation further complicated recovery efforts. The resignation of the Lebanese government one week after the explosion left the country without an effective decision-making body for several months. Political disputes over the distribution of foreign aid delayed the flow of funds, while concerns over government corruption led many international donors to hesitate in channeling assistance through state institutions (Sadek et al., 2022).

As a result, major international donors, including the European Union and the United Nations, opted to bypass government channels, instead directing funds to NGOs and international humanitarian organizations (Elmajzoub, 2021).

The government's inability to coordinate reconstruction efforts led to significant delays, inefficiencies, and unequal aid distribution, further intensifying public frustration and distrust in state institutions (Geha et al., 2020).

5.2. *Coordination Among Stakeholders*

The absence of a centralized recovery coordination system resulted in overlapping initiatives, inefficiencies, and the misallocation of aid, as various actors operated independently rather than as part of a unified response.

The key stakeholders influencing the effectiveness of this response are presented in Figure 1, which includes:

- Government agencies, which lacked the capacity to lead reconstruction efforts due to political instability and diminished public trust.
- Local NGOs, which played a critical role in providing shelter, medical assistance, and mental health support but faced funding constraints and lacked the infrastructure for large-scale rebuilding.
- International organizations and donors, including the UN, EU, and World Bank, which contributed financial and logistical support but encountered bureaucratic obstacles that delayed

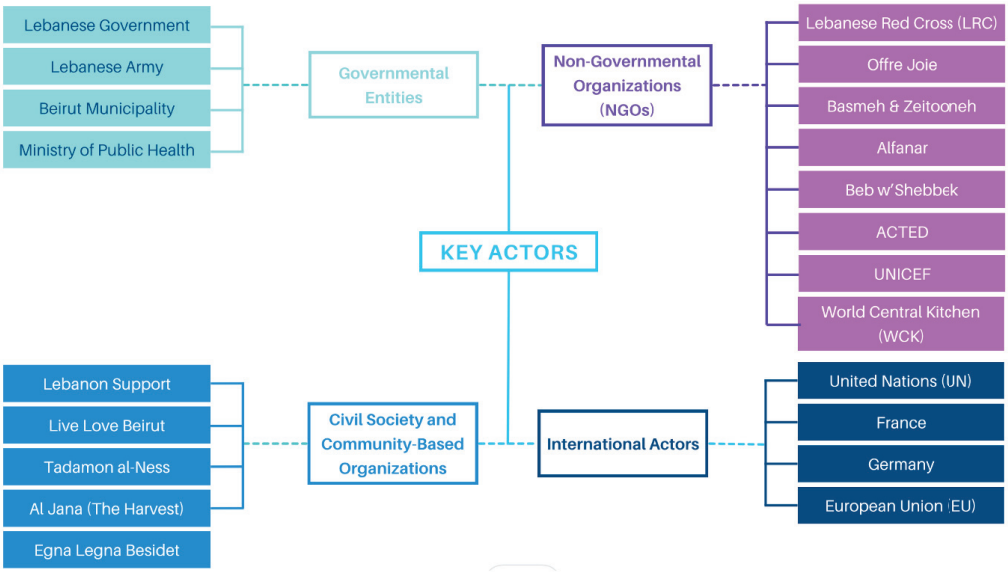

Fig. 1. key stakeholders influencing the effectiveness of this response

aid distribution.

- Community-based initiatives, such as Live Love Beirut and Offre Joie, which spearheaded grassroots rebuilding efforts but often operated in silos without overarching coordination (Sadek et al., 2022).

The absence of a national reconstruction authority meant that recovery decisions were fragmented and often driven by the priorities of individual organizations rather than a coordinated, city-wide strategy.

To address these challenges, experts have recommended the establishment of a centralized disaster recovery unit, modeled after similar agencies in other post-crisis settings, such as the Reconstruction Authority in post-earthquake Haiti (Aouad and Kaloustian, 2021). A coordinated approach would facilitate more efficient resource allocation, improve oversight, and ensure that reconstruction efforts align with long-term urban resilience planning.

5.3. *Beyond Response: Recovery Strategies*

For Beirut to achieve sustainable recovery, a comprehensive and participatory approach is required, prioritizing equitable resource distribution, infrastructure resilience, and social rehabilitation (Aouad and Kaloustian, 2021).

Key strategies proposed by urban planning and disaster resilience experts include:

- Decentralized rebuilding efforts, ensuring that local communities participate in decision-making rather than relying solely on top-down government directives.
- Sustainable urban planning, incorporating green infrastructure, earthquake-resistant building designs, and improved public transport networks (Sadek et al., 2022).
- Affordable housing solutions, as thousands remain displaced, while real estate speculation continues to drive up rental prices in already affected districts.
- Economic revitalization programs, aimed at incentivizing small businesses to reopen, generating employment opportunities, and restoring Beirut's position as a financial and cultural hub.

6. Conclusions

The Beirut Port explosion was a preventable disaster that highlighted Lebanon's systemic governance failures and weak disaster preparedness.

The absence of a national disaster response plan, combined with economic instability and political dysfunction, significantly hindered recovery efforts. While grassroots organizations and international NGOs played a critical role in mitigating the disaster's immediate effects, the lack of coordination among stakeholders and the government's slow response prolonged the crisis.

However, one of the most significant lessons from this catastrophe is that formal preparedness is not necessarily a prerequisite for an effective response. The extraordinary resilience and mobilization of Beirut's residents, volunteers, and civil society organizations demonstrated that community-driven efforts can often compensate for government inefficiencies. Spontaneous resilience driven by social solidarity and local networks played a crucial role in the initial relief phase, proving that disaster response is not only reliant on formal institutions. Yet, while informal preparedness and decentralized response mechanisms can mitigate the short-term effects of a crisis, they are not enough to sustain long-term recovery. Recovery is not just about rebuilding infrastructure ("the stones"), but also about economic, social, and psychological rehabilitation. A sustainable recovery strategy must focus on:

- Decentralized rebuilding efforts, ensuring that local communities participate in decision-making rather than relying solely on top-down government directives.
- Strengthening disaster risk governance, ensuring accountability in crisis response and management.
- Investing in community resilience, education, training, and localized emergency preparedness.
- Developing a centralized but flexible disaster response system, integrating formal institutions with grassroots initiatives.
- Prioritizing long-term urban resilience, with sustainable and inclusive rebuilding strategies.

The Beirut Port explosion reinforced the importance of both formal disaster preparedness and community-driven resilience. The first emergency responder in any crisis is often not the government, but the neighbor next door. While Lebanon's civil society demonstrated exceptional solidarity and response capacity, the absence of an institutionalized disaster management framework means that similar tragedies may recur if structural reforms are not implemented.

This paper highlights the need for a structured crisis management framework that integrates key pillars of risk science, including institutionalized risk governance, systematic hazard identification, coordinated emergency response, community-based resilience, and sustainable recovery planning. Incorporating these elements into future disaster management strategies can enhance preparedness and mitigate the impact of crises in politically and economically fragile states.

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