Collation of best practices for preparedness: lessons from disasters in Pakistan and Japan

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Abstract

Purpose – This study aims to compare the humanitarian supply chains and logistics of two countries in earthquake preparedness by modifying and using a previously established preparedness evaluation framework.

Design/methodology/approach – A European flood emergency management system (FEMS) is a seven-dimensional framework to assess a country's preparedness for flood emergencies. The FEMS framework was modified to apply to earthquakes. Leveraging a multiple explanatory case study approach with data analysis, the authors reconstructed the events of the earthquakes in Pakistan (2005) and Japan (2011) with an applied grading (1–5). Findings were evaluated within the adopted FEMS framework. From a practitioner's perspective, the framework is applicable and can accelerate support in the field.

Findings – Pakistan lacked emergency plans before the 2005 earthquake. In contrast, Japan possessed emergency plans before the disaster, helping minimise casualties. Overall, Japan demonstrated considerably better emergency management effectiveness. However, both countries significantly lacked the distribution of responsibilities among actors.

Originality/value – Practical factors in the humanitarian supply chain are well understood. However, synthesising individual factors into a comprehensive framework is difficult, which the study solves by applying and adopting the FEMS framework to earthquakes. The developed framework allows practitioners a structured baseline for prioritising measures in the field. Furthermore, this study exemplifies the usefulness of cross-hazard research within emergency management and preparedness in a real-world scenario.

Keywords Humanitarian logistics, Disaster events, Emergency management, Preparedness, Earthquake Japan 2011, Earthquake Pakistan 2005

Paper type Research paper

1. Introduction

The notion regarding earthquake forecast that the further one is from the last, the closer one is to the next holds true (Farooq, 2006). Increasingly, disasters are given more attention. Natural and man-made hazards summon extensive disasters disclosing various vulnerabilities. Identifying, observing and describing hazardous events helps provide solutions. Disasters are momentary, unpredictable disruptions of natural events flow, leaving behind environmental and humanitarian damage and destruction, often accompanied by considerable amounts of disability and death (Reis, 2018; Alexander, 2021). Earthquakes and tsunamis are the leading natural disasters globally (Nazarov, 2011). Inherently unexpected, unpredictable and significantly impacting the functionality of communities, disasters are hard to manage by routine procedures (Reis, 2018).

Acting quickly and accurately in the initial hours of disasters is essential to reduce the growing possibility of death and prevent escalation. Unfortunately, often, the environment becomes heavily impacted; many survivors are left devoid of essential resources (food, water, clothes and medical supplies); infrastructures collapse; many are entrapped; and delivering necessary care in the shortest possible time becomes challenging (Reis, 2018). Good supply chain management and logistics are invaluable for reaching out to people in need.

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Given that unpredictable events demand more efficient execution of operations to timely delivery supplies, the commercial business supply chains are rendered futile, and instead, humanitarian supply chains supervene. In contrast to commercial counterparts, human lives depend on response rapidity (Reis, 2018; da Costa *et al.*, 2014).

The *regular* and *humanitarian* supply chains are managed differently (Novoszel and Wakolbinger, 2022). The former more closely resembles the latter during extensive disruption, wherein destroyed roads and infrastructures disturb the regular supply chain operations (Novoszel and Wakolbinger, 2022; Kumar and Havey, 2013). The humanitarian supply chain requires significant flexibility and agility for timely response to extreme demand (Kumar and Havey, 2013; Besiou and van Wassenhove, 2020).

The management differences between standard and humanitarian supply chains can be visualised in Figure 1. Unlike the myriad demands of typical supply chains, there is a single demand and many required supplies in disaster relief (Kumar and Havey, 2013). The commercial and humanitarian supply chains encompass similar activities: preparation, planning, procurement, transportation, storage, tracking and customs clearance (da Costa *et al.*, 2014). Nevertheless, time is critical in the latter, as victim survival is time-sensitive.

Emergency management plays a crucial role in successful humanitarian relief and assumes a comprehensive set of functions in different phases of responding to risky situations. It consists of day-to-day activities, rescue operations, international organisation efforts coordination, restoring critical services and other emergent activities (Gilissen *et al.*, 2016). There is much room for improvement in preparedness planning and its application in catastrophes (Eriksson, 2009). Nevertheless, a country's emergency management is the cornerstone of the humanitarian supply chain. When countries and people are prepared with disaster action plans, valuable time is saved (Ranghieri and Ishiwatari, 2014).

As disasters receive more attention, the field of studying new disaster risks expands (Reinhardt and Ross, 2019). An expanding research field poses the need for new methods, systems and approaches to be included in humanitarian relief research. The factors for effective systems are documented and well-known (Boin and Hart, 2010). However, limited attempts to translate or synthesise those findings into frameworks for assessing current emergency management systems (Bossong and Hegemann, 2013; Kuipers *et al.*, 2015) or disaster preparedness (Cardona *et al.*, 2005; Carreño *et al.*, 2007) are available.

On top, current emergency research operates in country silos, preferring to focus on local activities and lacking standards or approaches allowing for cross-country comparison (Fenwick *et al.*, 2009).

Leveraging this gap, we apply and adopt a comprehensive approach uniting varied findings into a set of standards and definitions – the European flood emergency management system (FEMS). Finally, the practicality of the approach is adopted and tested in the context of earthquakes.

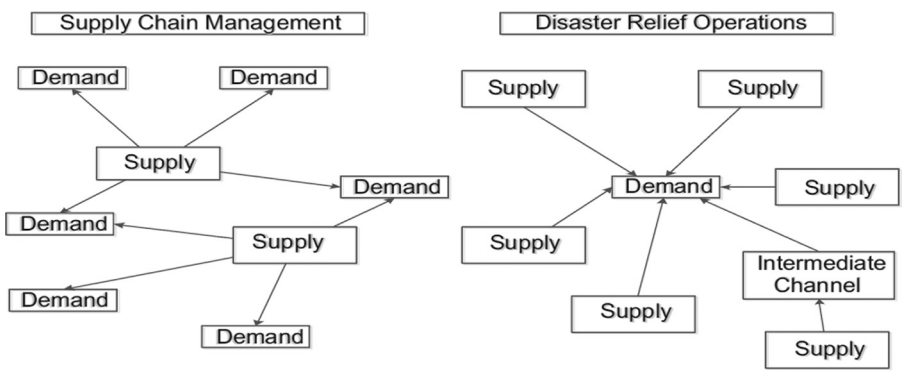
Numerous studies have compared disaster-response behaviours of industrialised and emerging countries (Marincioni, 2001). Similarly, this paper will address the significance of emergency management planning in Pakistan and Japan before experiencing impactful disasters. Japan and Pakistan were selected to compare a developing country with a developed country, hoping to receive insights on commonalities and differences. Applying a cross-country method with defined standards and definitions tests the FEMS framework applicability under varying contexts and supports exploring the FEMS framework practicability for practitioners (Gilissen *et al.*, 2016).

Current research stresses the importance of preparedness (Maon *et al.*, 2008; Tomasini and van Wassenhove, 2009; Franklin and Todt, 2014). Additionally, preparedness plays a vital role during recovery, where public awareness can be leveraged to restore higher standards and prevent recurring crises (Alexander, 2021). However, humanitarian logistics cannot offer a consistent universal definition of preparedness (Jahre *et al.*, 2016).

Exploiting this paradox and FEMS framework in mind, this paper assesses preparedness along seven dimensions to demonstrate a detailed description of how Japan and Pakistan prepared prior to and managed catastrophes; the relevance of the FEMS framework to earthquakes; and the feasibility of a rating system for preparedness assessment (Gilissen *et al.*, 2016).

Capitalising on the research gap, the paradox in preparedness definition and the need for cross-country research, the main objectives guiding the study are as follows:

Figure 1 Differences between standard and humanitarian supply chain management



Source: Figure credit (Kumar and Havey, 2013)

- assessing if a comprehensive framework can be applied across countries and natural disasters; and
- appraising the reliability of the FEMS framework in evaluating emergency management systems.

Aiming to answer the above objectives, the paper structure starts with methodology, where the approach and material selection process is outlined. Next, we apply the FEMS framework to Pakistan, followed by Japan. Firstly, a short background description is given, then capitalising on the seven dimensions to analyse the situation from the FEMS perspective. Finally, reflecting critically on the discussion between Japan and Pakistan, possible implications are synthesised at the end.

The FEM framework combines factors for effective systems and provides a comprehensive approach to accessing emergency management systems. The paper's uniqueness resides in applying and adopting the earthquake framework using a cross-country validation. This enables a unique view of the applicability and insights possible with the approach. Furthermore, lessons acquired and important nuances are possible to gain with comparative research, which we try to facilitate with this paper.

2. Methodology

The real-life events impervious to prospective surveys or experiments remain to be dissected in explanatory case studies. A case method offers a viable approach where the phenomenon needs to be fully understood, or the variables must be clarified. A further plus is that using multiple sources of evidence, guided by theoretical frameworks, is deemed helpful in generating valuable insights (Baxter and Jack, 2008; Meredith, 1998; Myers, 2009). An explanatory multiple case study design was followed, allowing parallel research on Pakistan and Japan regarding their emergency preparedness and a double-check for the reliability of the chosen framework (Voss *et al.*, 2002; Yin, 2014). A set of previously outlined criteria were adopted to ensure the acquisition of rigorous and defensible data (Meline, 2006; Modgil *et al.*, 2020).

We searched the ProQuest, JSTOR, Scopus, Web of Science and Google Scholar databases using keywords (Appendix 1) for English literature, elaborating on evidence of disaster management preparedness before the 2005 Pakistan and 2011 Japan earthquakes (Appendix 2). In addition, the study carefully included academic journal articles, organisation reports and official statements pertaining to our topic. The keywords and inclusion/exclusion criteria can be found in the Appendix 1. Qualitative data collection and analysis followed (Miles and Huberman, 1994). Finally, we evaluated evidence of pre-disaster emergency management preparedness in the two countries using the adopted FEMS framework (Gilissen *et al.*, 2016).

The FEMS is a previously published European framework evaluating emergency preparedness in floods (Gilissen *et al.*, 2016). Firstly, the framework indicators and benchmarks were adopted and extrapolated to earthquakes, followed by their application in the context of earthquakes in Pakistan (2005) and Japan (2011). The seven suggested indicators are graded according to effectiveness across 1 (emerging) to 5 (outstanding). They include Emergency disaster response planning; Arrangements for institutional learning; Requirements of exercising emergency arrangements; Distribution of responsibilities within and between emergency actors; Community preparedness; Provision of resources; and Arrangements for supporting recovery-based activities. Given that indicators two and three were cross-related and explained similar phenomena, a decision was made to combine them into a single entity. The detailed grading criteria of the adopted FEMS framework can be found in Appendix 3. Our database search and careful selection yielded 21 and 20 citations for Pakistan and Japan, respectively. Below is a summary of our findings, followed by evaluation within the adopted FEMS framework.

3. Disaster management in Pakistan

3.1 Background

On the morning of 8 October 2005, an earthquake with a Richter Scale magnitude of 7.6 struck 95 km Northeast of Pakistan's capital, Islamabad, killing at least 73.000 people and leaving around 3 million people in need of shelter (Asian Development Bank, 2005). The size of the area hit by the earthquake is compared to the Belgium land area (United Nations System in Pakistan and Government of the Islamic Republic of Pakistan, 2006). The people were facing a high chance of a second disaster – the cold, harsh Himalayan winter, exposing people to cold and starvation (Cosgrave and Herson, 2006). The humanitarian logistics and supply chain played significant roles; without good organisation, more lives would have been threatened.

Following its independence in 1947, Pakistan has focused mainly on managing flood risks. However, typical to the country's east floods impacted agricultural and economic growth and affected the more populated areas of the country (Mustafa and Wescoat, 2009).

In the 1950s, following other countries' examples, five-year national planning cycles were designed, mainly focusing on economic growth and industrial development. However, macroeconomic growth was the focus of national planning, neglecting national emergency preparedness and essential services provision strategies in response to disasters and hazards (Cheema *et al.*, 2016). National planning should overlook emergency preparedness and critical services (Talapatra *et al.*, 2019). Increasingly, Pakistan improved the social indicators in their eight consecutive five-year plans from 1993 to 1998. However, the focus was barely on response and relief *following* a natural disaster, and no plans were considered for regular prevention or preparedness for hazards (Cheema *et al.*, 2016; Tatham *et al.*, 2016).

Appendix 4 summarises the established plans that revolve around technical solutions to emergencies, focus on the river and canal systems, with little-to-no considerations for potential casualties or communication risks and social vulnerability assessment (Cheema *et al.*, 2016)

The Pakistani Government had little preparedness for any emergency (Khan and Ashori, 2016). Up to the 2005 earthquake, different institutions were carrying out the response to natural disasters, mainly on an *ad hoc* basis (Cochrane, 2008). The Damage Need Assessment states that even though Pakistan is prone to different natural disasters, it

still carries an *ad hoc* approach to disaster risk management, with the response and relief phase overshadowing *ex-ante* mitigation processes (Asian Development Bank, 2005).

Many different federal and local organisations were supposed to act in disaster response and relief. However, they needed to clearly define roles at different relief management phases and a clear structure for who was responsible for what steps in the process. This led to disorganised workflow and inefficient control systems, wherein institutions played overlapping roles in various relief management stages (United Nations System, 2005).

No authority carried the primary responsibility, depriving coherent policy-making to understand better and predict hazards and risks, promoting safety culture and providing adequate resources (Cheema *et al.*, 2016). In addition, regulatory and legislation gaps enhanced the inherent institutional weaknesses creating further difficulties for improvement and allowing vulnerabilities to persist (Deen, 2015). Facing a lack of central support, the affected communities increased political activity to push for improvement (Miles and Huberman, 1994).

Before the 2005 earthquake, Pakistan faced many challenges in fulfilling the population's health, education and poverty reduction needs. Furthermore, Pakistan's emergency management did not have the capacity to carry out necessary infrastructure and policy changes. Therefore, finding sufficient emergency planning resources was challenging (Cheema *et al.*, 2016). In addition, the geographical difficulties with access to affected areas, the paucity of necessary aid supplies and the lack of financial support significantly hindered the relief operations (da Costa *et al.*, 2014; Cosgrave and Nam, 2007).

3.2 Pakistan's response to the disaster

The earthquake struck Pakistan's Northwest Frontier Province and Pakistan-Administered Jammu and Kashmir, where 98% of the killed 75.000 population resided (Cosgrave and Herson, 2006). Following the earthquake, it was quickly recognised that a large-scale relief response was required. Consequently, the Federal Relief Commission (FRC), reporting directly to the Prime Minister, was established and headed by an army general (Cosgrave and Herson, 2006; Cochrane, 2008).

The FRC had two branches: a *military* branch responsible for the rescue, and a *civil* branch, that addressed the issues between departments and agencies. Moreover, all rehabilitation effort agencies had to go through the FRC (da Costa *et al.*, 2014). However, the military played a central role, being the initiators of rescue operations, accompanied by many volunteers from Pakistan (Reis, 2018; United Nations System in Pakistan and Government of the Islamic Republic of Pakistan, 2006). Therefore, despite a civilian president, a general assumption was that the military ran the country (United Nations System in Pakistan and Government of the Islamic Republic of Pakistan, 2006).

The military engagement was unique in capability and availability (Cosgrave and Herson, 2006; Rahman *et al.*, 2010). Their active role early following the earthquake, familiarity with national geography and, most importantly, the availability of operational equipment (helicopters, trucks and excavators) made the rescue easier (Reis, 2018). This is not surprising – Pakistan possesses the seventh-largest military force globally (Cosgrave and Herson, 2006). Similarly, in previous natural disasters (mainly floods) in Pakistan, the armed forces influenced disaster response and relief more significantly than any other government bodies (Meredith, 1998). Even though only 10% of the armed forces were involved, the remaining 90% being challenging to mobilise and support, they provided the core of rescue operation assets (Reis, 2018).

Following the earthquake, the Pakistan Government created two more bodies: The first one – Earthquake Reconstruction and Rehabilitation Authority (ERRA) –was created in 16 days to plan, coordinate, regulate and monitor the 20,000 square kilometres area affected by the earthquake. The second body – National Disaster Management Authority – was established in December to cover all natural disasters in the country (Watt *et al.*, 2009).

Consequent to the earthquake, bridges collapsed, and many landslides interrupted roads and covered them with sizable rocks. Due to significant road damage and mountainous terrain, the affected remote sites were often exclusively accessible by helicopters (Cosgrave and Nam, 2007). This was the case for many mountainous villages that were hard to reach otherwise (Cosgrave and Herson, 2006). Military helicopters were mainly used, but due to high demand and limited time, more helicopters were needed than the military could provide (Asian Development Bank, 2005).

The European Commission Humanitarian Office (ECHO) supplied additional helicopters with significantly (up to ten times) larger capacity. Furthermore, the ECHO supported the Atlas Logistics project, which provided overall on-land logistic support systems for humanitarian organisations. With ECHO's help, the most affected geographical areas requiring immediate assistance were easier to identify (Asian Development Bank, 2005). Nevertheless, acknowledging the alarming situation and realising that Pakistan alone could not handle the aftermath of the earthquake, President Pervez Musharraf requested urgent international help (Alexander, 2021).

The United Nations readily responded, although the consequences of the earthquake far extended their logistical and human resources. Therefore, NATO was consulted for additional assistance. Despite operating in Pakistan until October 2006, NATO acknowledges it as a significant challenge, as the affected area covered considerable distances (Reis, 2018; North Atlantic Treaty Orgasnization, NATO Handbook, Public Diplomacy Division, 2006; Jochems, 2006).

Notwithstanding the extraordinary efforts of the UN and other international organisations, Pakistan's army played the most prominent role, demonstrating a perfect example of military-civil cooperation in the disaster aftermath. Additionally, non-governmental support was offered from private sectors and civil societies to small self-help groups, helping with donations and business services. As a result, over US$1.4bn was donated/granted from bilateral, multilateral and private donors. The combination of the different circumstances in the earthquake aftermath made the relief response one of the most complex and time-sensitive relief operations in human history (United Nations System in Pakistan and Government of the Islamic Republic of Pakistan, 2006).

3.3 Phases of evolution in Pakistan case

3.3.1 Emergency planning for disaster response

The effectiveness of how a country responds to sudden disasters or emergencies heavily depends on government

preparedness. Planning, organising and coordinating specific operational procedures, coordination guidance or formulating supplementary plans are crucial to increase a community's capability of effective emergency responses (Henstra, 2010). Designing a proactive emergency plan is crucial in establishing priorities, tactical decision-making and coordinated operational action (Gilissen *et al.*, 2016). Unfortunately, Pakistan had almost no emergency preparedness (Khan and Khan, 2008). Diverse responsibilities are chaotically scattered across several different institutions that responded on an *ad-hoc* basis, with no central agency taking complete charge of disaster mitigation procedures at various levels (Cheema *et al.*, 2016; Cochrane, 2008).

3.3.2 Arrangements for institutional learning and requirements of exercising emergency arrangements

A civil defence department, established to prepare people for cases of emergency or a foreign country invasion, should have played a role in institutional learning. For example, the civil defence department helped inform people about safety measures during the wars with India between 1965 and 1971. Unfortunately, the department lacked all kinds of resources (human, financial and logistic), the offices were understaffed, and affording to train only the schoolteachers, the department failed to teach life-saving skills to volunteers to participate in rescue groups. Pakistan's flood-centric policy framework could not effectively institutionalise disaster management to mitigate the aftermath (Cheema *et al.*, 2016).

3.3.3 Distribution within and between emergency arrangements

Several government institutions and policies had severe issues with risk communication, adding to casualties and failing to house a sustainable emergency management cycle (Cheema *et al.*, 2016). In the early stages of rescue operations, the coordination between different rescue operators was described as chaotic (Cosgrave and Nam, 2007).

Further complications arose between participants of relief operations with the introduction of UN-commissioned cluster systems and the absence of coordination of donors (Cosgrave and Nam, 2007; Action Aid International, 2012). Institutions lacked sensible cross-talk in carrying out different tasks, overwhelmingly acting on an *ad hoc* basis (Cochrane, 2008). Notably, 27 different organisations within Pakistan needed more predefined roles and clear structures in relief management. Suffices it to say, the distribution of actions, plans and arrangements between sectors and organisations should be established before a disaster (Meredith, 1998).

3.3.4 Community preparedness

The communication between organisations in Pakistan is criticised for dramatically impaired informational flow (Ramsden, 2014). A limited effort was exerted to engage the community in the planning and implementation stages. The local communities were informed over mosques to spread announcements, and their involvement in emergency management via preparedness plans was near-to-non-existent (Cheema *et al.*, 2016).

Additionally, civil society organisations were constantly partaking in emergency management. There were many non-profit organisations and civic groups that supported government agencies in rescue operations, accessed and provided relief in areas beyond the reach of governmental institutions, suggesting that Pakistan's disaster management should include communal and local societies in multiple stages of emergency management infrastructures (Cheema *et al.*, 2016).

3.3.5 Provision of resources

As previously mentioned, having the right equipment (helicopters, trucks and excavators), the Pakistani armed forces played an essential role in rescue operations even before the 2005 disaster (Reis, 2018; Cheema *et al.*, 2016). Nevertheless, for a disaster of that magnitude, additional support was required for necessary supplies and financial resources (Reis, 2018).

3.3.6 Arrangements for supporting recovery-based activities

The Pakistan earthquake victims will have to continue relying on aid from foreign countries to recover from the disaster (Farooq, 2006) fully. Accordingly, the American Red Cross has greatly supported the three-year Balakot maternal and child health project, six union councils and aided 27 villages. Furthermore, the Danish and Canadian Red Cross Organisations orchestrated health programs for Balakot and Banna communities, respectively (International Federation of Red Cross and Red Crescent Societies, Final Report, 2012). Nevertheless, the ERRA was established as responsible for rebuilding and repairing the devitalised infrastructure in the long run (Phister *et al.*, 2009).

ERRA has regularly organised meetings for the International Federation of Red Cross and Red Crescent Societies reconstruction teams to ensure that government-approved standards are followed during the recovery and reconstruction projects. During the emergency, recovery programs offered primary health care, psychosocial support, water, sanitation and hygiene promotion. Additional programs were organised in capacity building in health and HIV prevention. Furthermore, the most vulnerable households were supplied with maise, fertilisers, wheat seeds, fruit plants, gardening equipment and toolkits to support and improve agriculture and secure sustenance. In this project, some 73 community organisations were formed (International Federation of Red Cross and Red Crescent Societies, Final Report, 2012). The USA alone contributed $510m for the relief phase, and more than $113m were donated from private support (Terhune, 2006).

4. Disaster management in Japan

4.1 Background

Geographically, Japan is one of the most disaster-exposed countries globally. Strikingly, 20% of the world's earthquakes with six and above magnitude occur in Japan. Additionally, 7% of the world's active volcanos are in Japan (Nazarov, 2011).

On 11 March 2011, at 14:46 local time, the northeast coast of Japan was struck by a 9.0 magnitude earthquake, with a hypocentre 32 km below sea level, triggering one of the most significant tsunamis in human history. The latter spread along 600 km of the Tohoku region's eastern coastline, with 38 meters wave height and covering 4–5km inland (Fraser *et al.*, 2013; Esteban *et al.*, 2015; Davis *et al.*, 2012; Japanese Red Cross Society, 2013; Naoi *et al.*, 2012). The event was described as *a megadisaster*, impacting over 560 square

kilometres of Japan, killing 15,882 people and leaving 2,668 missings (Ishigaki *et al.*, 2013; Parmar *et al.*, 2017). Furthermore, over 20 countries along the pacific shores released warnings about possible tsunami outreach (Norio *et al.*, 2011). As a result, a Japanese island was moved around 3.6 meters to the east, and the country's west coast descended by about 60 cm (Norio *et al.*, 2011).

Earthquakes and major landslides at ocean depths often trigger tsunamis (Nazarov, 2011). However, not only was Japan hit by a massive earthquake followed by a colossal tsunami. Nevertheless, the events further triggered a nuclear accident in the Fukushima power plant, reaching level 7 on the International Nuclear and Radiological Event Scale, comparable to the 1986 Chornobyl nuclear disaster. The events, described as the world's second-largest nuclear accident, produced a power supply failure and disrupted supply chains worldwide (Davis *et al.*, 2012; Japanese Red Cross Society, 2013; World Bank, 2012; Umeda, 2011).

Japan ensured constant community awareness of natural disaster possibilities, which is why the national and local governments supported communities' engagement in disaster risk management, defining their roles and commitments over local institutions (World Bank, 2012). For example, based on past disasters, the Tohoku region locals marked tsunami water heights with stones, aiming to warn their residents to avoid building houses below defined levels. Slowly, however, the attention to these warnings faded (Naoi *et al.*, 2012). Despite the annual evacuation drills, most participants were the elderly and children, few large disasters occurred over the years, and the public's awareness decreased over time (Ranghieri and Ishiwatari, 2014). However, Tohoku locals remained adequately prepared thanks to their excellent disaster preparedness education: many locals had disaster preparedness kits loaded with food, water, first-aid supplies, radios and batteries (Greer, 2012).

Japanese communities possess remarkable mutual social obligation and cooperation skills concerning disasters, warranting increased public participation and high efficacy when disaster strikes (Paton *et al.*, 2010). Furthermore, the Japanese time-tested traditional collectivism and resilience contributed to recovery and reconstruction in the aftermath of the disaster (Goulding *et al.*, 2018). Therefore, it is essential to interactively interconnect the different government agencies and local communities in their efforts at accurate risk estimation to address disaster vulnerability (World Bank, 2012).

Japan is a highly developed country with advanced industry, economy and society, and unlike its developing counterparts, it affords to build disaster prediction systems and prepares necessary strategies (Paton *et al.*, 2010). Rather than focusing on personnel and organisational development, employee education, organisational changes or attempting to alter their current disaster response methodology, the country instead focuses disaster management on structural solutions, such as developing new technologies and spending 7% of their annual budget on structural mitigation solutions (Greer, 2012). Before the 2011 earthquake, Japan had established high-technology systems issuing warnings of upcoming tsunamis via satellite communications and numerous monitoring stations facilitated by real-time transponders (Ranghieri and Ishiwatari, 2014).

An outstanding emergency response system has been noted in Japan, whereby every city follows an established emergency evacuation plan, with predefined refuge areas (primarily schools and city parks) to which people self-evacuate in disaster cases (Parmar *et al.*, 2017; Yamada, 2007).

Additionally, directions to evacuation facilities were strategically placed on electricity poles and along roadsides. Planned evacuation routes were adopted to reduce evacuation times significantly, and over 70,000 designated tsunami evacuation areas were engineered on high ground or inland, far enough from the coast to shield from floods (Ranghieri and Ishiwatari, 2014; Fraser *et al.*, 2013).

With its extended natural disaster history, Japan focuses its relief system on advanced technology development, annual emergency drills and on-the-job training. Emergency drills are mainly organised on the anniversaries of past sizable disasters (Ranghieri and Ishiwatari, 2014; Greer, 2012). According to the World Bank, many lives were saved, and mortality was minimised thanks to local community participation in emergency preparedness, using learned survival knowledge, effective decision-making and risk management (World Bank, 2012; Paton *et al.*, 2010).

The "Tsunami, ten-den-ko" is the Tohoku people's mindset, asserting that each person is responsible for their individual, timely evacuation. As a result, valuable time is saved based on mutual trust, as parents no longer hurry to pick up their children from school, costing their own lives (Ishigaki *et al.*, 2013).

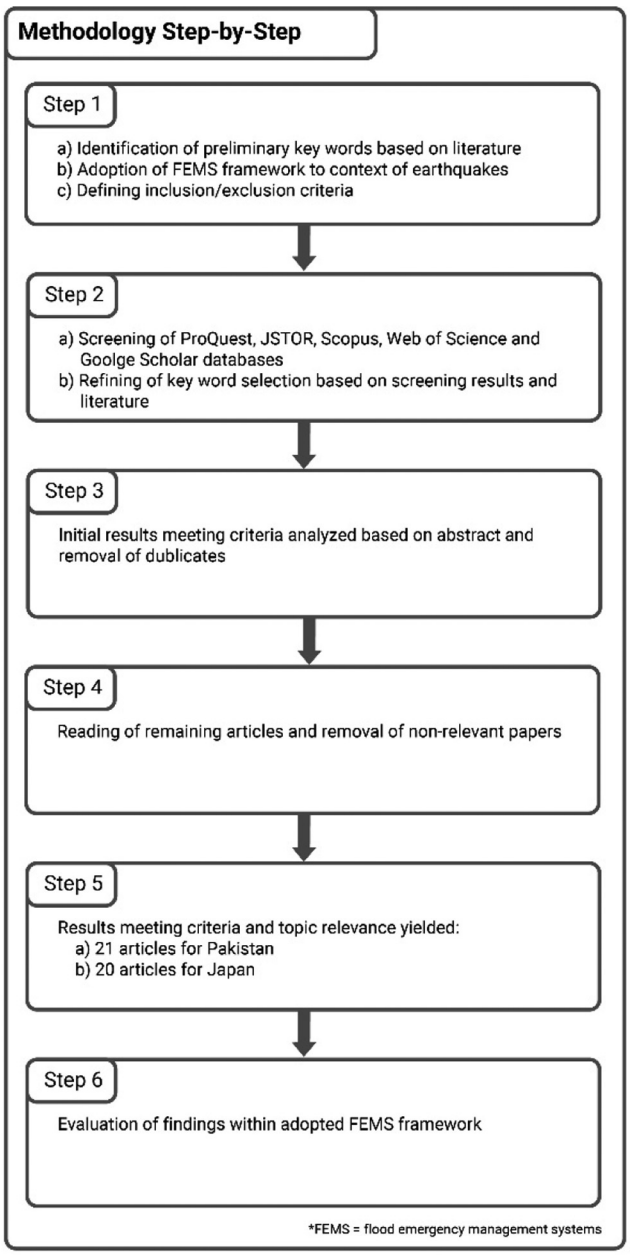
Japan took many Tsunami impact reduction countermeasures (Esteban *et al.*, 2015). For example, multiple buildings in multiple locations were built in line with the Tsunami Vertical Building Evacuation strategies – constructing towers or buildings above the highest water levels within tsunami-prone areas (Fraser *et al.*, 2013). Furthermore, considering the frequency of tsunamis, the Tohoku region invested approximately US$10bn in covering 300 km of coastal land with defence structures and breakwaters, according to national government technical standards and guidelines (Ranghieri and Ishiwatari, 2014). As a result, the Tohoku region can be seen as a top tsunami-prepared region globally, with seriously taken emergency preparedness and high disaster awareness (Esteban *et al.*, 2015).

Nevertheless, Japan had yet to take advantage of a significant opportunity regarding its disaster preparedness. A combined earthquake prediction algorithm (M8-MSc), using a standard protocol to determine with at least a 70% success rate the possibility of earthquakes with > 8.0 magnitude, announced a forecast in 2001, almost 10 years before the 2011 Tohoku earthquake (Davis *et al.*, 2012). Disregarding the forecast, Japan did not consider additional preparations. The Japanese experts were surprised by the Tohoku Earthquake, despite the M8-MSc forecast, as it failed to communicate the information to the earthquake prediction community. The miscommunication resulted in a missed opportunity to use vital time and information towards preparing for a large-scale disaster (Davis *et al.*, 2012). Instead, Japan used the experience to improve its disaster management system. The focus shifted to improving emergency response policies and regulations and allocating roles and responsibilities locally and nationally (World Bank, 2012).

Adopted in 1961, the Disaster Countermeasures Basis (JDCB.), the act covers disaster planning, preparedness, emergency response and recovery phase measures and requires financial requirements. Additionally, it assumes three-level disaster management councils (Nazarov, 2011; Greer, 2012).

As illustrated in Figure 2, the Central Disaster Management Council represents the highest national level, followed by the Local Disaster Management and Municipal Disaster Councils at the prefectural levels (Nazarov, 2011). The national government is responsible for the overall emergency management strategy, coordination, funds provision and government budget adoption. In contrast, the local government coordinates the administrative and operational levels of diverse functions, such as providing adequate education, exercising emergency and safety drills and issuing warnings of upcoming disasters (Ranghieri and Ishiwatari, 2014).

Figure 2 Methodology step-by-step overview



Source: Figure created by author

The national government supervises the emergency response phase coordination processes and supplies local governments with critical information about the disaster. In exchange, the local government informs the national government about the extent of the damage (Nazarov, 2011). Figure 3 illustrates the organisation of disaster response mechanisms in Japan. Every local government (communities, villages, cities) is responsible for its local disaster plan. The national government becomes involved only when local governments are overwhelmed and unable to act accordingly. Highlighting responsibility on the lower levels, escalated only if capabilities of greater coordination are required (Greer, 2012).

Despite Japan's general disaster preparedness, at the time of the Great Tohoku Disaster, a myriad of systems failed, and valuable time was lost. The aggregate of the earthquake, the tsunami and the nuclear power accident were unprecedented (Umeda, 2011).

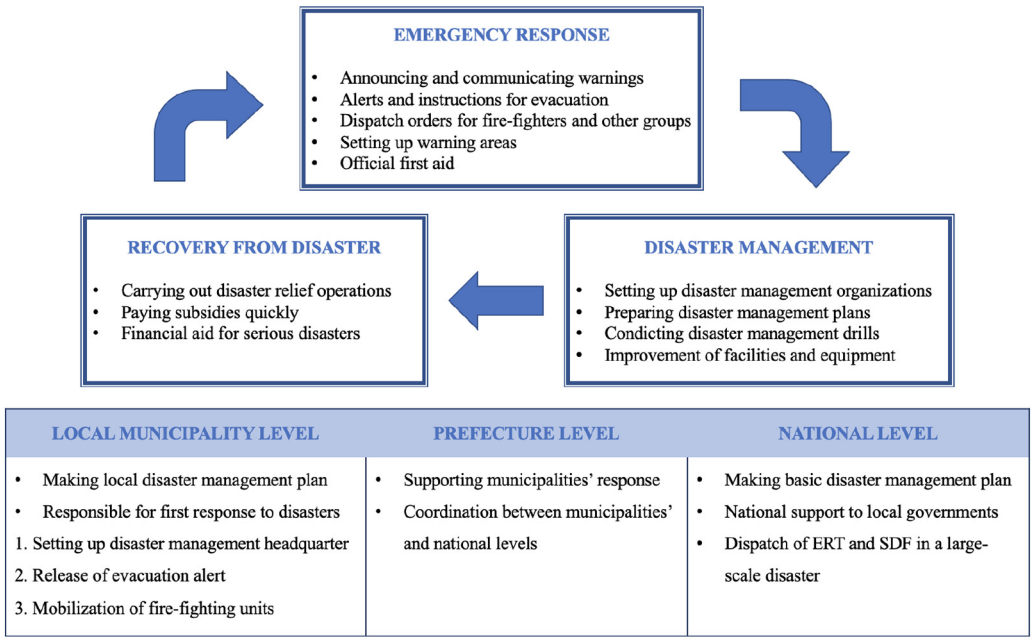
4.2 Japan's response to the disaster

Although the 3-min-long earthquake was one of the strongest ever recorded and the fourth largest in history, there were few casualties exclusively caused by the earthquake, thanks to the precise and strict government-adopted building codes (1923), issuing quake-resistant buildings (Naoi *et al.*, 2012; Ishigaki *et al.*, 2013; World Bank, 2012).

Additionally, to address the frequent tsunamis, the Tohoku region invested approximately US$10bn, shielding 300 km of coastal land with defence structures and breakwaters (Ranghieri and Ishiwatari, 2014). However, the 2011 Tohoku Tsunami was beyond expectations, collapsing more than 190 of the 300 km of coastal defences (World Bank, 2012). The 6–7 m tall waves following the massive earthquake far surpassed the predicted tsunami heights to be halted by the coastal defence (Holguín-Veras *et al.*, 2014). Despite the exceeding heights, some Tohoku areas were successfully shielded by the coastal defences (Ranghieri and Ishiwatari, 2014). The coastal defences and heights across the Japanese east coast are visualised in Figure 4. Design heights in the upper country are influenced by historical data, while lower country designs lean on storm predictions. Even though the tsunami collapsed more than half of the barriers, it lost strength when reaching inland (World Bank, 2012). Local community preparedness played an important role, with the unexpectedly sizeable tsunami overpowering the coastal defence (Ranghieri and Ishiwatari, 2014; Holguín-Veras *et al.*, 2014). Regularly partaking in emergency drills, the locals were well-prepared and responded quickly upon warning. Many lives were saved thanks to safe evacuation literacy (Ranghieri and Ishiwatari, 2014) exclusively.

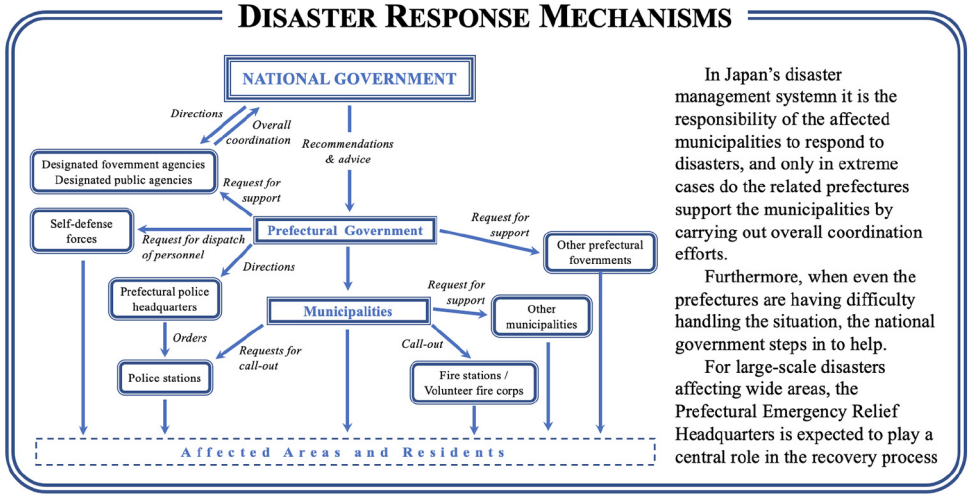
Due to the earthquake detection system's warning 30 s before its occurrence, 19 Japanese bullet trains were notified. Furthermore, the cutting-edge automatic system terminated trains' electricity supplies, allowing trains driving at their maximum 270 km/h velocity to brake seconds before the

Figure 3 Basic scheme of the Disaster Countermeasures Basic Act



Source: Authors' rendition of Nazarov (2011)

Figure 4 Disaster response mechanisms in Japan



Source: Authors' rendition of Nazarov (2011)

earthquake, thereby saving thousands of passengers (Ranghieri and Ishiwatari, 2014; World Bank, 2012; Greer, 2012).

The installed seismic intensity meters and seismographs all over Japan issued warnings about the upcoming earthquake to railway operators, schools, factories, people's cell phones and other general operators about 30 s before the earthquake. Despite the relatively short warning time for a 9.0 magnitude earthquake, there was enough time for hospital staff to halt medical procedures, for students to hide under desks at schools and universities and for bullet trains to pull brakes (Greer, 2012). Moreover, over 80% of the people believed that the early warnings helped them to survive the incoming disaster (Ranghieri and Ishiwatari, 2014; Rahman *et al.*, 2021).

After partaking in numerous emergency drills, the residents were familiar with existing evacuation routes, allowing them to move quickly to higher grounds (Holguín-Veras *et al.*, 2014). For example, about 230 people living near the East Sendai Expressway survived by rushing to the expressway as the tsunami approached. The expressway was approximately 4 km from the coast and 7–10 meters above sea level, successfully providing an evacuation route (Ranghieri and Ishiwatari, 2014).

Despite the relatively successful emergency preparedness, Japan did not anticipate a strong earthquake to be further superimposed by a tsunami, which is why local governments had difficulties responding to the situation. However, the national agencies were quick to approximate ends (Ranghieri and Ishiwatari, 2014). Furthermore, the national government financially supported the local governments based on a decision made two days following the disaster and authorised by the Act on Special Financial Aid of the Disaster Response Basic Law (Umeda, 2011).

Not to waste further time, the Japanese Government established a Reconstruction Agency shortly after the Tohoku disaster (Japanese Red Cross Society, 2013). Furthermore, just 1 h into the earthquake, the prime minister, supported by the Disaster Response Basic Law, entrenched the Emergency Disaster Response Headquarters to coordinate and oversee the execution of national and local government measures (Umeda, 2011).

The government immediately issued 540 aircraft, 60 vessels and 107,000 Japan Self Defense Forces (JSDF) police teams, as well as firefighters and emergency medical personnel, who rescued 90.000 victims, constituting approximately 70% of the rescues (Ranghieri and Ishiwatari, 2014; Umeda, 2011). In addition, the Japan Coast Guard (J.C.G.) took immediate action after the earthquake to partake in multiple emergency response activities, rescuing 360 victims and retrieving 302 bodies (Nazarov, 2011). Moreover, using helicopters and planes, the Ministry of Land, Infrastructure, Transportation and Tourism (MLITT) was able to inspect the affected roads and critical infrastructures and further donated approximately 2,000 closed-circuit television cameras (Holguín-Veras *et al.*, 2014).

However, the coordination between national organisations, civil society, local governments, international assistance and volunteers could have been more functional, leading to confusion and duplication in relief efforts and multiple emergency shelters in the same affected areas (Ranghieri and Ishiwatari, 2014). In addition, a significant problem was the fuel shortage. Another problem occurred with the interruption of telecommunications, compromising real-time information exchange between stakeholders (World Bank, 2012). Nevertheless, the JSDF and non-governmental organisations coordinated the emergency food allocation to the shelters (Ranghieri and Ishiwatari, 2014).

In the Emergency Relief Phase, the Japanese Red Cross Society (JRCS) handed out relief goods to the affected locals, which consisted of blankets, emergency kits and sleeping sets, together with medical and mental help. Additionally, JRCS set up operation centres across the region (Japanese Red Cross Society, 2013). The emergency kits, loaded with the required goods (food, water, medicine, blankets and other necessities), were provided by the Japanese Government (Umeda, 2011).

Following the earthquake, the majority hurried to the provided public shelters, but there was a growing need for shelter alternatives (Tatsuki, 2012; Rahman *et al.*, 2014). Resultantly, approximately 2,500 evacuation shelters were organised in the affected areas, with even more facilities located outside the region (World Bank, 2012). Additionally, more than 400,000 people were taking shelter in public facilities (schools, hotels) or hosted by friends and relatives outside the region (Japanese Red Cross Society, 2013). Moreover, approximately 5,500 people successfully took shelter in the designated Tsunami Vertical Evacuation Buildings (Fraser *et al.*, 2013).

Before the disaster, workshops and engagements were organised, with local participation, to raise awareness of the vertical evacuation strategy (Fraser *et al.*, 2013). The service stations, parking and rest areas along highways were also furnished into rescue operation bases, accommodated with toilets and running electricity (Ranghieri and Ishiwatari, 2014). Although many municipalities had storages loaded with necessary equipment and emergency/disaster preparedness kits, most were damaged or gone (Japanese Red Cross Society, 2013).

For emergency scenarios, a three-day food supply was stored at the Tohoku University Hospital. However, the supply barely sufficed for the patients, leaving the hospital staff without food and having to request a resupply from other hospitals (Parmar *et al.*, 2017).

The exchange of information on events needed more real-time synchronisation. Nevertheless, the government collected information through social media and the internet, among other means, and the communication and information delivery were exceptionally well, ensuring that locals had realistic expectations for emergency relief (World Bank, 2012).

Thanks to the timely response of MLITT, the roads were cleared in less than seven days, almost all ports were functional again in only four days, and most of the water supply was running within thirty days. In contrast, the electricity was back much earlier, in less than a week (World Bank, 2012).

Initially, medical needs were given the highest priority, owing to reliance on local governments to provide food, water and sanitation. However, the latter was unable to act as expected due to the disaster's significant impact, leaving many shelters short of essential supplies (Parmar *et al.*, 2017).

The fixed-line and mobile telephone infrastructures sustained severe damage, severely impaired communication systems and leading to incongruencies in patient transport and transfer between hospitals and the JSDF (Ranghieri and Ishiwatari, 2014; Parmar *et al.*, 2017). Social media and FM radio were essential in communicating information on areas to receive relief goods and general safety measures (Ranghieri and Ishiwatari, 2014).

Even though a nuclear disaster followed the earthquake, the nuclear plants were effectively protected from earthquakes, explaining why the nuclear reactors stopped operating immediately after the earthquake. Several UN agencies, like the World Health Organisation and the International Atomic Energy Agency, took action in response to the nuclear disaster (Norio *et al.*, 2011). Japan requested international help as rescue teams from across Australia, New Zealand, South Korea, the UK and the USA responded. More countries provided their willingness to help than initially requested, compiling donations of over 1,300 tons of relief goods in the first two weeks (Norio *et al.*, 2011). Emergency relief was offered from 163 countries and 43 international organisations (World Bank, 2012). Japan welcomed aid and workers from other countries to help with emergency relief (Greer, 2012). The USA alone provided approximately 16,000 military personnel for relief operations (Ranghieri and Ishiwatari, 2014).

Kuwait donated $520m worth of crude oil (Japanese Red Cross Society, 2013).

To support the living of the affected Japanese people, numerous new laws were legislated. Financial grants were issued to victims who lost family members, were injured or disabled or whose houses sustained severe damage. The government also provided loans for treating injuries, house repairs and reconstruction. Furthermore, measures were taken to reduce taxes for victims. Unemployment benefits were issued to people with affected workplaces (Umeda, 2011). The recovery was estimated at 10 years, and approximately $250bn were allocated within its first half, leading to The World Bank's rough estimate of the overall sustained damage being $235bn (Umeda, 2011; Park *et al.*, 2013).

Even though Japan is considered one of the most disaster-prepared countries, it still suffered heavily from the Tohoku earthquake. Having preparedness to mitigate an earthquake or a tsunami without significant consequences, it could not have anticipated the tsunami and the nuclear catastrophe to follow the earthquake (Greer, 2012).

4.3 Evaluation of the emergency management in Japan in 2011

4.3.1 Emergency planning for disaster response

The Tohoku community has been well prepared, thanks to disaster preparedness education and annual emergency drills (Greer, 2012). Furthermore, local and national governments supported the locals' engagement in disaster risk management, constantly reinstituting awareness of natural disaster possibilities (World Bank, 2012).

Every city had an emergency evacuation plan. The 1961 Disaster Countermeasures Basic Act, which included emergency planning, preparedness, response and financial measures, was designed to organise disaster management councils at the national prefecture. At the local level, whereby the national level was responsible for the overall strategy and coordination, the prefecture level coordinated the interaction between municipalities and the national level and supported municipality response. In addition, the local level was responsible for developing individual initial disaster response plans (Nazarov, 2011; Ranghieri and Ishiwatari, 2014; Greer, 2012; Yamada, 2007).

4.3.2 Arrangements for institutional learning and requirements of exercising emergency arrangements

The older generation, who has experienced past disasters, marked the heights of previous tsunamis waves with stones, reminding others to avoid building houses below the set stone levels (Naoi *et al.*, 2012). Emergency drills were organised annually, mostly on past disaster anniversaries (Ranghieri and Ishiwatari, 2014). The local communities were engaged in disaster risk management, organised by the national and local governments (World Bank, 2012). Owing to the excellent disaster preparedness education, many locals possessed emergency kits at home, and there was a widespread mindset in the Tohoku region supporting individual evacuation (Ishigaki *et al.*, 2013; Greer, 2012).

4.3.3 Distribution of responsibilities within and between emergency actors

The JDCB Act differentiated national, prefecture and local levels. The national level carried responsibility for developing basic disaster management plans and supporting the local governments when needed for the overall strategy and emergency management coordination (Nazarov, 2011). Conversely, the local governments coordinated operational and administrative levels of diverse activities (Ranghieri and Ishiwatari, 2014).

Following the disaster, the local governments received financial support from the national government, and the latter shortly established a Reconstruction Agency and headquarters for Emergency Disaster Response. The JCG and JSDF, along with other government organisations, immediately helped with victim retrieval and rescue operations (Nazarov, 2011; Ranghieri and Ishiwatari, 2014; Japanese Red Cross Society, 2013; Umeda, 2011). The JRCS was responsible for distributing relief resources and setting up operation centres (Japanese Red Cross Society, 2013). The MLITT took responsibility for inspecting affected roads and infrastructures, clearing the roads within seven days and revitalising the functionality of ports (World Bank, 2012; Holguín-Veras *et al.*, 2014).

Nevertheless, the coordination between different organisations and stakeholders was poorly-functional, affected by the significant fuel shortages and telecommunication interruptions caused by the disaster (Ranghieri and Ishiwatari, 2014; World Bank, 2012).

4.3.4 Community preparedness

Evacuation drills took place annually, maintaining constant community awareness via inclusion within the disaster risk management, wherein individual commitments and roles were defined. Most locals had prepared emergency kits encompassing food, water and first-aid kits (Ranghieri and Ishiwatari, 2014; World Bank, 2012; Greer, 2012). Locals also secured their furniture to prevent being overturned in disasters (Naoi *et al.*, 2012). Every Japanese city had an emergency evacuation plan (Yamada, 2007), and information on evacuation shelter locations was displayed on electricity poles (Ranghieri and Ishiwatari, 2014). Communities regularly participated in emergency preparedness, gaining valuable knowledge (Paton *et al.*, 2010). The people were aware of tsunami evacuation routes thanks to emergency drills and moved to the higher ground faster (Holguín-Veras *et al.*, 2014). A nearby expressway was provided as an evacuation route (Ranghieri and Ishiwatari, 2014). The locals recognised the vertical evacuation strategy (Fraser *et al.*, 2013).

4.3.5 Provision of resources

The national government is responsible, among other essential duties, for funding in times of disaster. Carrying a long history of disasters, Japan spent approximately 7% of the annual budget on solutions for mitigation. Furthermore, the government issued 540 aircraft, 60 vessels and over 100,000 personnel in JSDF, police teams, firefighters and medical professionals, supported by the JCG and the MLITT. Furthermore, approximately 2,500 evacuation shelters were set up, 896 medical teams were deployed, 40,000 emergency kits were distributed, and over 1,000 supplies essential for

operating evacuation centres were provided (Nazarov, 2011; Ranghieri and Ishiwatari, 2014; Japanese Red Cross Society, 2013; World Bank, 2012; Greer, 2012; Holguín-Veras *et al.*, 2014).

Nevertheless, Japan was not cast alone to face the disaster aftermath. Over 1,300 tons of relief goods were donated by other countries and international organisations in the first two weeks. For example, Kuwait donated $520m worth of crude oil, and the USA provided approximately 16,000 military personnel to help relief operations (Ranghieri and Ishiwatari, 2014; Japanese Red Cross Society, 2013; Norio *et al.*, 2011).

4.3.6 Arrangements for supporting recovery-based activities.
The JDCB Act covered statements on the recovery phase of disaster aftermath. Additionally, to support the daily living of the affected, new laws were legislated by the government and financial grants, loans and tax relief were issued to victims (Umeda, 2011; Greer, 2012).

Moreover, the Government of Japan supported the affected people for more than two years, helping to reconstruct buildings and houses, combating unemployment and attempting to revitalise the industry. In addition, small- and medium-sized businesses received financial support from the government to help the affected people find employment. As a result, around $250bn was provided within the disaster's first five years to reconstruct the affected region (Japanese Red Cross Society, 2013; Umeda, 2011).

5. Discussion

The seven indicators used in Pakistan's and Japan's emergency management efficiency evaluation demonstrated the following results.

5.1 Pakistan

The I indicator – *emergency planning for disaster response* – suggested that Pakistan mainly responded to the emergency on *an ad-hoc* basis (Cochrane, 2008). No plans were devised prior to 2005 [38]. Therefore, some authors would suggest the first indicator be scaled at *(1) minimal to non-existent* (Gilissen *et al.*, 2016).

The II and III indicators – *arrangements for institutional learning and requirements of exercising emergency arrangements* – suggested that only a limited number of persons (schoolteachers) were trained in emergency preparedness, and Pakistan did not have effective institutional disaster management (Cheema *et al.*, 2016). These indicators would be scaled as *(2) emerging*.

The IV indicator – *distribution within and between emergency actors* – suggested that there were cooperation issues between participants and that different institutions were carrying out different tasks on *an ad hoc* basis, thereby similarly scaling at *(1) minimal to non-existent*.

The V indicator – *community preparedness* – suggests no local community involvement in emergency management and scales at *(1) minimal to non-existent* (Cheema *et al.*, 2016).

The VI indicator – Provision of resources – points to Pakistan's armed forces providing most of the required resources, albeit requesting additional help and support, scaling as *(3) moderate* (Reis, 2018; da Costa *et al.*, 2014).

The VII indicator can also be scaled as *(3) moderate*, considering the sizable donations from other countries and international organisations and the numerous community organisations formed to support recovery (International Federation of Red Cross and Red Crescent Societies, Final Report, 2012; Terhune, 2006).

Overall, Pakistan scored *1.8* on average, between (1) minimal-to-absent and (2) emerging emergency planning.

5.2 Japan

Japan undertook different emergency planning measures for disaster response and integrated an emergency evacuation plan – The Disaster Risk Management – harnessing community involvement. In addition, the annual disaster preparedness education and emergency drills, distribution of responsibilities across three levels (national, prefecture and local) and support of the JDCB Act helped with preparations. Accordingly, the emergency disaster response planning – the I indicator – is scaled at *(5) outstanding* (Nazarov, 2011; Gilissen *et al.*, 2016; Yamada, 2007).

Next, the II and III indicators revealed the local's participation in annual emergency drills and engagement in Disaster Risk Management. Considering many people had ready-to-go emergency kits lying at home, the indicators are scaled at *(4) significant* (Ranghieri and Ishiwatari, 2014; World Bank, 2012; Greer, 2012).

Based on the JDCB Act, there was a clear division across the national, prefecture and local levels regarding the distribution of responsibilities – the IV indicator. Although the Reconstruction Agency and the Emergency Disaster Response headquarters were set up shortly after the disaster, the JCG, SDF, the JRCS, the MLITT and many other international stakeholders took part in the overall relief, albeit with poorly-functional coordination, thereby scaling the indicator at *(1) minimal* (Nazarov, 2011; Ranghieri and Ishiwatari, 2014; Japanese Red Cross Society, 2013; Norio *et al.*, 2011; Umeda, 2011; Holguín-Veras *et al.*, 2014).

The V indicator is scaled as *(5) outstanding*, given that community awareness of constant dangers from natural disasters was addressed correctly, emergency drills were held annually and emergency evacuation plans could be found in every city. Moreover, by partaking in emergency drills, the locals were aware of evacuation routes and the specific actions to be taken and possessed emergency kits prepared at homes (Nazarov, 2011; Ranghieri and Ishiwatari, 2014; World Bank, 2012; Greer, 2012; Yamada, 2007; Holguín-Veras *et al.*, 2014).

The VI indicator of resources provision is scaled as *(4) significant*, as the national government spent approximately 7% of the annual budget on mitigation solutions. Additionally, the government issued numerous aircraft, vessels and the JSDF, together with the police, firefighters and medical teams. Furthermore, support was offered by the JCG, the MLITT and numerous foreign countries and international organisations (Nazarov, 2011; Norio *et al.*, 2011; Greer, 2012).

The recovery-based activity arrangements – the VII indicator – is scaled as *(5) outstanding*, revealing how the national government supported the victims through financial grants, loans and tax reliefs, helping to reconstruct houses and promoting employment. Furthermore, the JDCB Act covered the recovery phase of disaster aftermath (Japanese Red Cross Society, 2013).

Japan's Emergency Management indicators averaged *(4)*, suggesting significant emergency planning efforts.

6. Conclusion

The aftermath of the 2005 Pakistan earthquake was sizable, affecting 3.5 million people, killing over 78,000 and leaving around 3 million homeless. Almost six years later, Japan was struck by a Richter scale 9.0 earthquake, killing 15,882 people (Asian Development Bank, 2005; Ishigaki *et al.*, 2013).

In this study, we presented a framework adapted to earthquakes. Based on the FEMS framework as a basis, we designed the framework along the exact dimensions, allowing for adoptions to permit applicability to earthquakes. Aiming to address the research gap, we focus on assessing the possibility of the FEMS framework as a synthesised approach for emergency management systems and disaster preparedness. Considering current research is mostly locally focused, we expanded the study to include two countries to allow for a cross-country comparison. Japan and Pakistan both experienced devastating earthquakes. Both earthquakes are the basis for our case studies. We identified articles from different sources and used this as the basis to evaluate and rate the preparedness of both countries. Based on the assessment, we compared both countries, experiencing commonalities and differences.

The success of a comprehensive framework depends on its applicability to different contexts. Moreover, a cross-country lens is necessary to advance emergency management systems and disaster preparedness in a globalised world with increased natural disasters. Identifying Japan and Pakistan as the testing ground, the FEMS framework proved helpful in comparing the two countries as presented in Figure 6. As an island nation and landlocked Pakistan, Japan has different geography and development status. However, considering those differences, the framework worked surprisingly well in assessing both countries, allowing for cross-country comparability.

Apart from a cross-country perspective, the critical question is the applicability to natural disasters. FEMS started as a framework developed for flood catastrophes and preparedness assessment. This study adopted the framework outlines for earthquakes. The framework proved helpful for individual natural disasters. However, it was observed that a quick adaption to various natural disasters proves difficult. Therefore, we identified existing challenges on specific requirements of earthquakes compared to floods.

Further, country-specific guidelines might make it necessary to adopt definitions on individual dimensions. Besides the mentioned challenges, the overall adopted framework can be applied to natural disasters after the framework has been adopted to the relevant natural disaster. These discussions highlight the cross-country comparability after the framework has been adopted to the respective natural hazard, answering our first objective.

Mapping the seven dimensions to the emergency preparedness of Japan and Pakistan allowed for a deeper understanding of the dimension reliability. It was found that Pakistan possessed close-to-non-existent emergency plans prior to the 2005 earthquake. The seven indicators demonstrated an absent/minimal to an emerging average score. In contrast, owing to its unfavourable geography, Japan was experienced past disasters and invested in various emergency planning measures to be better prepared in the face of a disaster. This helped Japan's response to the 2011 earthquake, and despite the numerous casualties, considerably more were avoided in lieu of emergency planning. Despite their vigorous efforts, Japan could not anticipate a triple disaster. As a result, the emergency planning effectiveness indicators scored *significant*ly superior to Pakistan's case. A visual representation of the evaluation above can be found in Figure 5. It is clearly illustrated that Japan was significantly more effective in emergency management than Pakistan.

Nevertheless, both countries scored *absent or minimum* concerning IV – responsibility distribution indicator. Lacking a transparent distribution of responsibilities in both countries is surprising as one would expect this to be a starting point in preparedness. Next, the combination of indicators II and III proves helpful. However, applying the retro perspective makes distinguishing both dimensions hard.

Based on the assessment above, the seven indicators are reliable in evaluating emergency management systems and therefore answer our second objective.

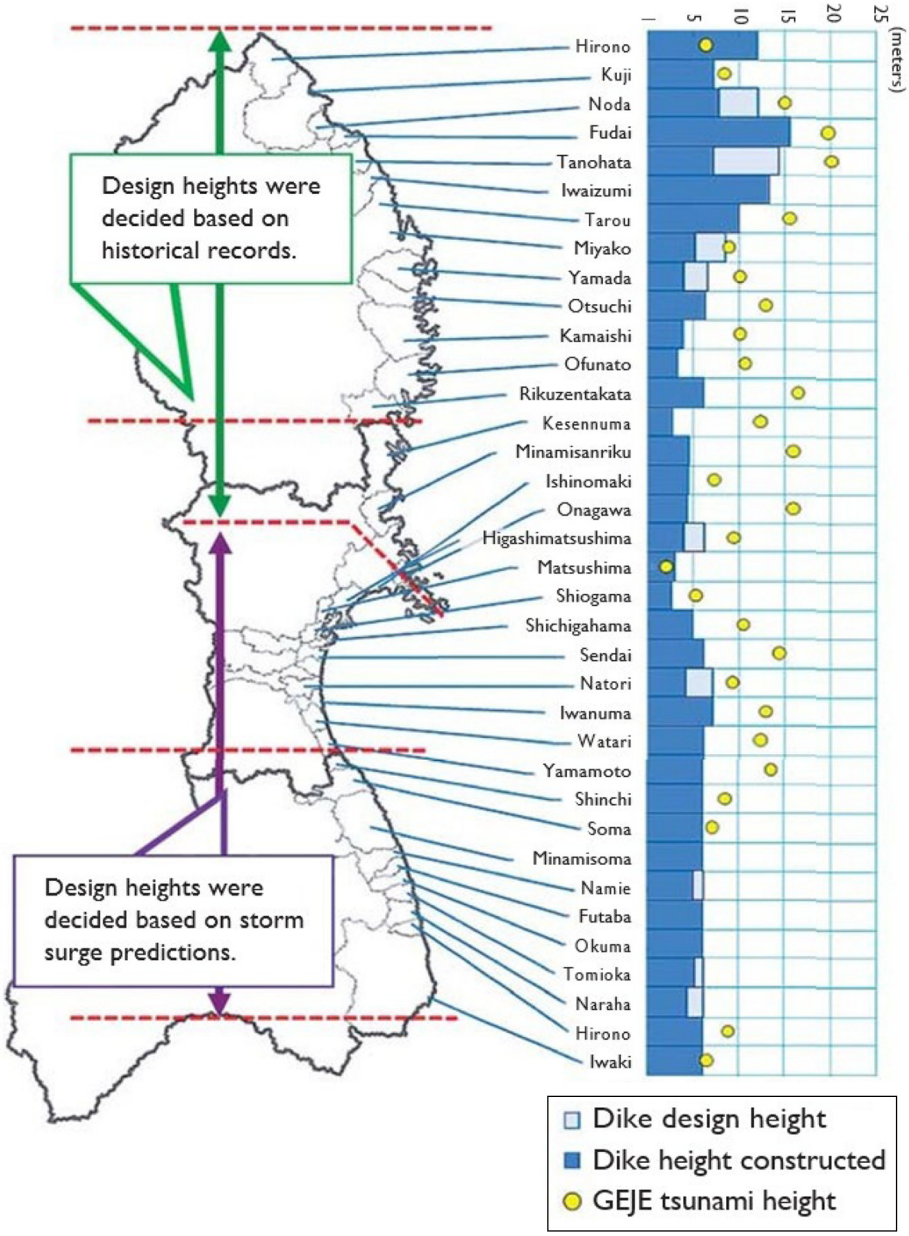
Considering the impact of research, the field of studying new risks associated with disasters expands (Reinhardt and Ross, 2019). Known factors (Boin and Hart, 2010) and a limited synthesis of factors in emergency management systems (Bossong and Hegemann, 2013; Kuipers *et al.*, 2015) or disaster preparedness (Cardona *et al.*, 2005; Carreño *et al.*, 2007) make it necessary to expand in the neglected field. As a field, the results emphasised in objective one show cast the cross-country comparability of the framework, highlighting the need to adjust frameworks to the specific natural hazard contexts. The implication for research underlines the need to adjust frameworks to individual hazards but that cross-country comparability is feasible and necessary to advance the research field.

Pakistan and Japan learned from the sizable disasters, and many other countries became aware of the importance of having well-prepared emergency plans to face a disaster. Despite the researchers' interests in humanitarian operations, the academic output has not largely impacted practice (Besiou and van Wassenhove, 2020).

Practitioners profit from the study on two dimensions. Firstly, the frameworks developed and applied to the context of floods and, respectively, earthquakes allow for a straightforward assessment with definitions for each category. The recognised cross-country comparability permits a quick assessment of the preparedness level in various countries. Secondly, a structured baseline of the capabilities allows for prioritising measures to address gaps and strengthens already established measures. A framework enabling a rating and baselining saves time and accelerates the impact in the field.

Considering the pros and cons of the above-studied approach and framework validation, professionals and

Figure 5 Determining dike height



Source: Figure credit (Eriksson, 2009)

researchers might find further encouragement to expand on cross-country studies and frameworks and synthesise individual factors.

7. Research limitations

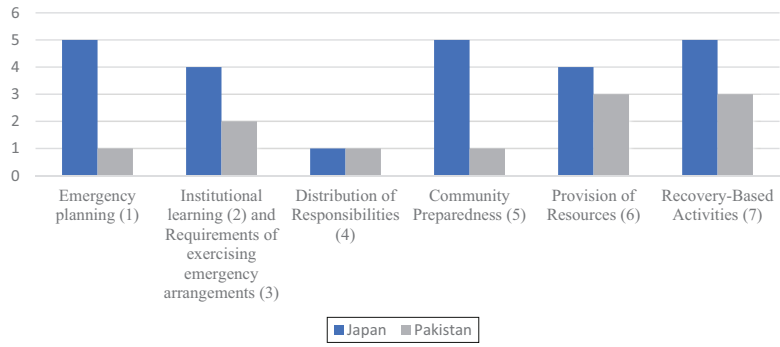
This paper provides information on the state of emergency management in Pakistan and Japan before being hit by sizable disasters and the countries' responses regarding humanitarian and relief operations. The paucity of new and detailed data regarding the Pakistan earthquake, contemporary empirical research in the form of interviews and more recent articles are acknowledged as limitations.

8. Future research

Other potential research areas would be exploring the framework's applicability outside the context of floods and earthquakes. Considering the range of possible catastrophes, numerous other case studies are possible. Research could also focus on problems relevant to practitioners, collect field data knowledge and undertake modern context data analysis (Besiou and van Wassenhove, 2020).

Given the framework's usefulness, enhancing certain aspects or adding further dimensions would be interesting to follow up upon. Establishing the framework as a comprehensive catastrophe preparedness assessment needs follow-up research and further proof of feasibility.

Figure 6 Evaluation of the effectiveness of emergency management in Pakistan and Japan



Source: Figure created by author

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Further reading

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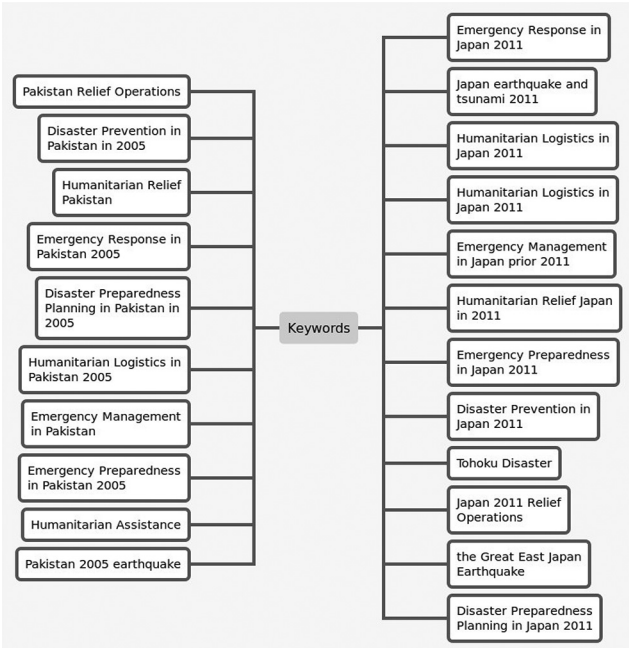
Appendix 1

Figure A1 Search keywords



Source: Figure created by author

Appendix 2

Table A1 Inclusion and exclusion criteria

Criterion	Rationale	Included	Excluded
Time frame	The focus was 2005 and 2011 earthquakes and the years preceding the respective events	citations dating 2005 −2018 (one exception – a 1996 article)	Sources preceding 2005 or following 2018
Language	Papers in English were chosen for simplicity	Papers written or translated into English	Japanese, Hindi, other languages
Publication type	To ensure the credibility and reliability	Peer-reviewed journal articles, books, conference abstracts, government, NGO, international organisation reports, doctoral dissertations	editorials, opinions non-scholarly magazine newspaper articles, blog posts videos movies

Source: Figure created by author

Appendix 3

Table A2 Adopted framework indicators and benchmarks of effective FEMS for earthquake (Gilissen *et al.*, 2016)

Criterion		(1) Absent/minimal	(2) Emerging	(3) Moderate	(4) Significant	(5) Outstanding
i	Emergency planning for earthquake response	Basic emergency plans to inform emergency professionals on responding to generic hazard events, no earthquake-specific emergency management plans. Plans not tailored to local conditions. Incident responses mainly reactive and uninformed by planning.	As above, but locally tailored (not nationally consistent), planning documents exist for generic emergencies	As above, but nationally consistent, locally tailored planning documents exist, sporadic evidence for local earthquake emergency plans, not based on periodic risk assessment	Nationally consistent generic and earthquake-specific emergency planning established locally/regionally, informed by hazard assessment	Nationally consistent generic and earthquake-specific planning established to build risk-response capacity based on ongoing local scale risk assessment and monitoring. Planning integrates hazard assessment with vulnerability information (e.g. critical infrastructure location, population characteristics), accompanied by/aligned with subnational/national planning document
ii	Arrangements for institutional learning	Little to no attempts at identifying lessons learned from incident management	Debriefing protocols follow significant incidents to help identify strengths/ weaknesses of incident management	Accompanying debriefing practices, emergency management is subject to public scrutiny and review following significant incidents. Attempts are made to implement learned lessons	Beyond significant incident responses, evidence for proactive institutional learning, efforts to facilitate knowledge exchange within/between administrative/ management districts, periodically evaluate management system performance	Procedures established to promote frequent institutional learning and following emergency events, mechanisms to facilitate knowledge exchange, sharing experiences and best practices (e.g. frequent meetings, computer-based tools supporting dialogue between emergency professionals). Emergency management periodically subjected to public scrutiny/review
iii	Requirements of exercising emergency arrangements	Exercises are initiated on an ad hoc basis in some emergency management districts, only. There are no specific provisions for earthquake incident management	As above, exercising is sporadic, with some examples of provisions for earthquake incident management	Training and exercising emergency protocols is an established practice and involves relevant emergency professionals. There are more examples of specific training/ exercising for earthquake incident management, but this is not a requirement nor common practice	As above, but additional actors are occasionally engaged in emergency exercises (e.g. communities, private sector and media). Training/ exercising for earthquake incident management is an established practice and is nationally consistent	Training and exercising are initiated periodically to test planning and operational procedures for specific hazard events at local to national scales. All emergency professionals are involved, and additional actors are engaged in exercises, where relevant. Exercises are seen as an additional means of raising citizen awareness of earthquake risks

(***continued***)

Table A2

Criterion		(1) Absent/minimal	(2) Emerging	(3) Moderate	(4) Significant	(5) Outstanding
iv	Distribution of responsibilities within and between emergency actors	Different organisations/ agencies involved in emergency responses, lack of coordination	Clear legislation clarifying roles/ responsibilities of emergency actors ensuring a nationally consistent approach	Sporadic mechanisms to facilitate integrated work between emergency actors across the country. Mechanisms for upscaling/downscaling emergency responses reportedly lacking effectiveness	Mechanisms for facilitating work integration between emergency actors embedded in emergency management governance and practice, including public agencies/ organisations, critical infrastructure providers, civil society organisations, voluntary sector. Clear understanding of roles/ responsibilities, effective response upscaling/ downscaling mechanisms	Facilitated inter-organisational work. Clear roles/ responsibilities distinction, established communication and information exchange channels. Mechanisms for upscaling/downscaling emergency responses through operational, tactical and strategic decision-making
v	Community preparedness	Little-to-no attempts at public risk consulting, public unaware of emergency procedures	Nationally inconsistent, sporadic efforts at public risk awareness	Emergency professionals consistently required (by law/policy) to harness public risk awareness. Examples of emergency professionals actively engaging communities in preparedness	Active, widespread community engagement across the country	Emergency professionals actively involved in enhancing public earthquake preparedness at household/community levels across administrative/emergency management districts
vi	Provision of resources (financial, human resources, equipment, decision support tools)	Lacking resources to support emergency professional roles	Essential supply of necessary resources to support emergency professional roles	Nationally inconsistent availability of additional resources supporting earthquake response	Nationally established additional resources supporting earthquake response, resource-sharing/ distribution mechanisms	Emergency (earthquake) management, adequately resourced regarding funding, equipment provision, tools supporting preparation, response, recovery activities, single/ multi-agency decision-making. Additional arrangements to engage further resources
vii	Arrangements for supporting recovery-based activities	Little-to-no immediate recovery planning following emergency incidents	Evidence of some planning for sparce recovery measures (e.g. return of critical infrastructure)	Nationally guided Emergency professionals required (law/policy) to develop recovery plans detailing roles/ responsibilities, impact assessment, outlining provisions for likely impacts	Arrangements at all territorial levels to trigger handover from response to recovery phases of emergency management, coordinate recovery activities	Established general, earthquake-specific recovery management planning, dealing with physical damage, humanitarian issues (e.g. displaced communities, victim welfare needs), environmental, economic, and infrastructure issues. for other agencies/ organisations involvement per request. Governance structures to coordinate recovery activities according to periodic impact assessment, successfully manage cross-border issues

Source: Figure created by author

Appendix 4

Table A3 Five year plans for 1955–2030 (Cheema *et al.*, 2016) authors' rendition of (Cheema *et al.*, 2016)

Five-year plans	Disaster management policies, plans, major events
1955–1960	The 1958 National Calamities Act passed following recurrent East Pakistan floods. The scope was strictly limited to response/relief, focusing on counter-flooding measures restricted to river floods, neglecting flash flooding
1960–1965	Increased budget allocations for flood control measures
1965–1970	Continued focus on river flooding, enhanced flood protection measures to increase cultivation area
1970–1975	A cyclone hit East Pakistan, establishing federal level Emergency Relief Cell. Due to political crisis, the government abandoned elaborate flood control program to be developed by World Bank support. Floods in 1973, 1976
1971–1976	Ongoing political crisis hindered annual planning: little implementation in 1971–1976. The 1958 National Calamities Act was adapted to West Pakistan Calamities Act, focusing on response/relief
1978–1983	1977 Federal Flood Commission centralised flood control policy. Provincial/district government roles further reduced local hazard mitigation planning. Technocratic tendencies held with extension of irrigation/drainage systems
1983–1988	A general absence of grassroots participation by affected communities
1993–1998	Focus on canal lining, remodelling, floodwater use for land recharging. Non-structural measures, e.g. promotion of water resources research in universities
1998–2003	Flood control measures followed previous plans, but abandoned following 9/11 and Pakistan's new role in the "war on terror"
2005–2010	Shift from flood-centred policy to a multi-hazard approach. UNDP provided technical support, incorporated lessons learned from the Dec 26, 2004 Boxing Day tsunami
2030 Vision	Poverty alleviation through control over natural hazards (floods, droughts), introduction of agriculture insurance against drought

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