Institutional Foundations of Management of Natural Disasters: Lessons from the Recent Cyclones in Mozambique

Book Section

Institutional foundations of management of natural disasters: lessons from the recent cyclones in Mozambique

Anna John (Open University, UK, anna.john@open.ac.uk)

Gil Jose Vicente (Universidade Amazonas, Brazil)

Introduction

In this chapter, we focus on the problem of natural disasters. A natural disaster may be defined as 'an act of nature of such magnitude as to create a catastrophic situation in which the day-to-day patterns of life are suddenly disrupted and people are plunged into helplessness and suffering, and, as a result, need food, clothing, shelter, medical and nursing care and other necessities of life, and protection against unfavourable environmental factors' (WHO 1971).

Over the past 70 years, natural disasters have become more frequent (Dominey-Howes, 2015) and their effects have become more devastating (Heteren, Hirt and Veken, 2020). This accelerated the process of institutionalization of natural disasters leading to the formation of formal institutions (e.g. planning programmes, cooperation agreements and regulatory systems), informal institutions (e.g. networks and family connections) and soft institutions (e.g. mindset, norms, behaviours, and best practices) supporting management of natural disasters at all levels (Kahn 2005; Raschky, 2008; Breckner *et al*., 2016; Shah *et al.,* 2019; Choudhury, 2019).

The institutionalization process has re-shaped management of natural disasters by shifting the attention of their policy makers and natural disaster managers from traditional reactive approaches focusing on post-hoc responses to natural disasters to new proactive approaches focusing on resilience to natural disasters prioritizing anticipation and prevention of calamities and mitigation of their possible effects (Navrud and Magnussen, 2013; Johnson *et al*., 2011; Liu, 2019; Correa, 2011). Today we can witness these new approaches in many contexts including Caribbean Isles (Murray and Watson, 2019), Latin America (Caruso, 2017), Europe and Northern America (Bubeck, 2017), and Asia and Pacific (Brassard *et al.,* 2016).

Yet, having been researched mainly in advanced economies, the institutional approaches to managing natural disasters have received less attention among scholars focusing on more vulnerable contexts—developing economies (Boustan *et al.,* 2020). As a result, our knowledge of the institutional approaches to natural disasters remains partial. It is not clear how they form and, most importantly, make developing economies more resilient to natural disasters. In this chapter, we explore these questions. Our discussion benefits from various examples and we

place an emphasis on a context with a high frequency and magnitude of natural disasters—Mozambique.

The remainder of the chapter is structured as follows. First, we set conceptual and methodological frameworks. Methodologically, we draw on a D-CIMO-logic—for the discussion of the institutionalization- management of natural disasters link (John 2020). Then, we present key institutional approaches to management of natural disasters. We further move on to the discussion of the institutional challenges of management of natural disasters in Mozambique. The chapter ends with recommendations for policy makers and managers of natural disasters in Mozambique and discusses insights of the study for other similar contexts abroad.

Conceptual framework

We view management of natural disasters as a system. In the subsequent sections, we discuss its key elements: a strategy, a process, a context, and a mechanism (System 2020). Figure 1 summarises these elements.

Strategy

Management of natural disasters involves strategic interventions—decisions and actions—of various actors (e.g. governments, businesses, NGOs, and international organizations), needed to avoid and, where the avoidance is not possible at all, to reduce risks and effects of natural disasters (Rayamajhee and Bohara, 2019). The strategy element is shown in the centre of Figure 1. It comprises interventions and outcomes they lead to.

Process

Management of natural disasters is not static. Instead, it unfolds as a process comprising three stages: a pre-event stage, an event stage, and a post-event stage (Antoniou and Potsiou, 2020; Knez *et al*, 2018; Yang and Jahan, 2018). For example, at a pre-event stage, managerial interventions may focus on developing intelligence systems helping to foresee, prevent and prepare for disasters (Amit *et al.,* 2016). Relief operations are the central issue at the event stage (Dubey *et al*., 2019). The post-event management may focus on recovery activities and improvements for developing greater resilience to natural disasters in the future (De Mel *et al*., 2012; Karlaftis *et al.,* 2007; Kermanshachi et al., 2019).

The stages are linked. Specifically, what happens at a preceding stage will affect interventions and their outcomes at a subsequent stage (Doyle *et al.,* 2019). The process element is shown in the lower part of Figure 1. It comprises three stages: a pre-event stage, event stage and post-

event stage. The arrows between the stages show implications of preceding stages on subsequent stages.

Mechanism

Management of natural disasters involves different mechanisms whereby interventions lead to specific outcomes (Zhang, 2019; Ha, 2019; Sinha, 1999). In Figure 1, the mechanism elements are shown as ovals linking interventions and outcomes.

Context

Management of natural disasters is embedded into a wider context. In this chapter, we place an emphasis on an institutional context. This comprises formal institutions (e.g. planning, cooperation, and regulatory systems), informal institutions (e.g. networks and family connections), and soft institutions (e.g. mindset, norms, behaviours, and best practices) (Wagner et al., 2014). The context is not static. It changes as we move along a natural disaster process.

An institutional context affects interventions and outcomes of these interventions. In addition, it triggers mechanisms whereby certain interventions lead to specific outcomes. For example, there may be institutional contexts that generate defensive mechanisms helping to mitigate a disaster's effects. Alternatively, some institutional contexts may trigger transformative mechanisms helping to control and prevent certain disasters. The context element is shown in the upper part of Figure 1. It indicates the institutional context underlying a natural disaster.

Figure 1: System of management of natural disasters
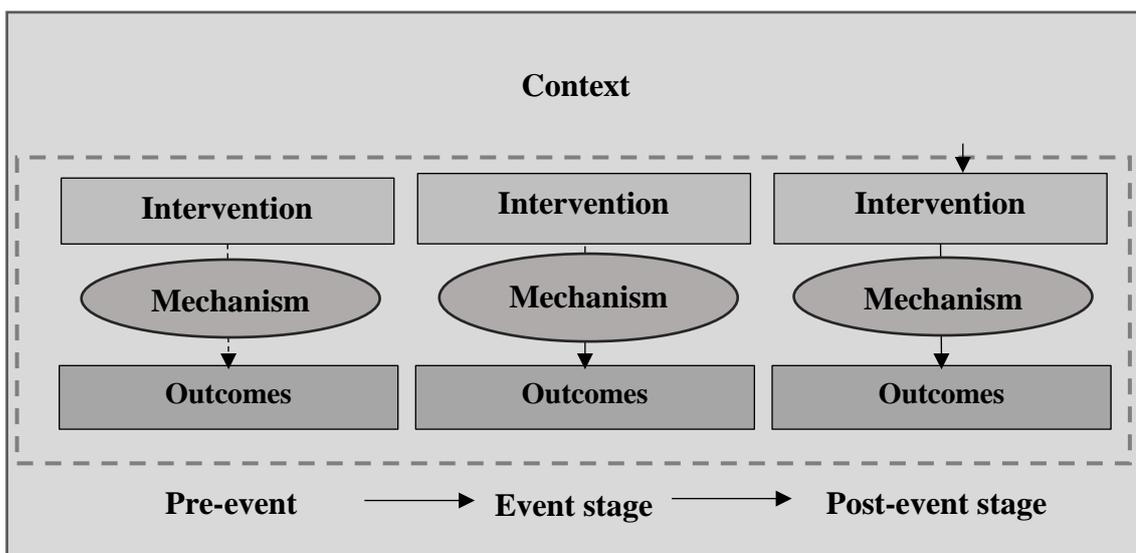
Source: authors

Methodological framework

Research process

Our research process comprises two steps. First, we review prior research to offer a better understanding of the role of institutions in management of natural disasters in developing economies. Prior research does not fully integrate institutions into management of natural disasters. Indeed, it reports differences in the effectiveness of interventions across institutional contexts. Yet, it does not explain institutional mechanisms whereby the same intervention may lead to different outcomes. We address this deficiency by performing a synthesis of prior research. The objective of this synthesis is to explore possible mechanisms underlying interventions in different institutional contexts. Our sample includes publications in books and journals ranked 2* and above in the CABS (Chartered Association of Business Schools) system and with an impact factor greater than 1 in the JCR (Journal Citation Reports) of the Clarivate. Our assumption is that targeting higher rank journals will help to source publications of higher theoretical and methodological rigor.

Second, drawing on our synthesis' findings, we explore the role of institutions in management of natural disasters in Mozambique. Our focus is on the country's most frequent disasters—cyclones— which have happened since the end of the national civil war in 1992. The data comes from our unique collection of secondary sources (e.g. journals, magazines, and newspapers) published in English and Portuguese languages in Mozambique and abroad.

Method

We use a new methodological approach—D (dynamic)-CIMO-logic (John, 2020)—to syntheses at both stages of our research process. First, we apply it to integrate theoretical advances of prior research. Second, it will be used to structure our discussion of the role of institutions in management of natural disasters in Mozambique.

The D-CIMO-logic is a framework that allows performing both structural and temporal syntheses of data (John, 2020). Like the traditional CIMO-logic (Denyer *et al.*, 2008), it may be used to perform a structural synthesis by exploring CIMO—context, intervention, mechanisms, and outcomes—structures. Specifically, it investigates how contexts shape mechanisms whereby specific interventions lead to certain outcomes. Yet, unlike the traditional CIMO-logic, the new approach may be used for a temporal synthesis—an integration of data for capturing changes in CIMO structures over time. This temporal synthesis is critical to a deeper understanding of processes underlying phenomena. The temporal synthesis is a valuable tool for learning about management of natural disasters because these too may be viewed as processes.

Figure 2 shows our methodological framework. The upper part of the figure depicts two steps in our research process: (1) Review of prior research and (2) Discussion of the recent cyclones in Mozambique. The lower part of the figure presents methodological decisions at each step of our research process. In both steps, we use D-CIMO logic to perform structural and temporal syntheses.

Figure 2: Methodological framework

Research process

Step 1: Review of prior research into institutional approaches to management of natural disasters	**Step 2:** Discussion of the recent cyclones in Mozambique
D-CIMO logic: *Structural synthesis *Temporal synthesis	**D-CIMO logic**: *Structural synthesis *Temporal synthesis
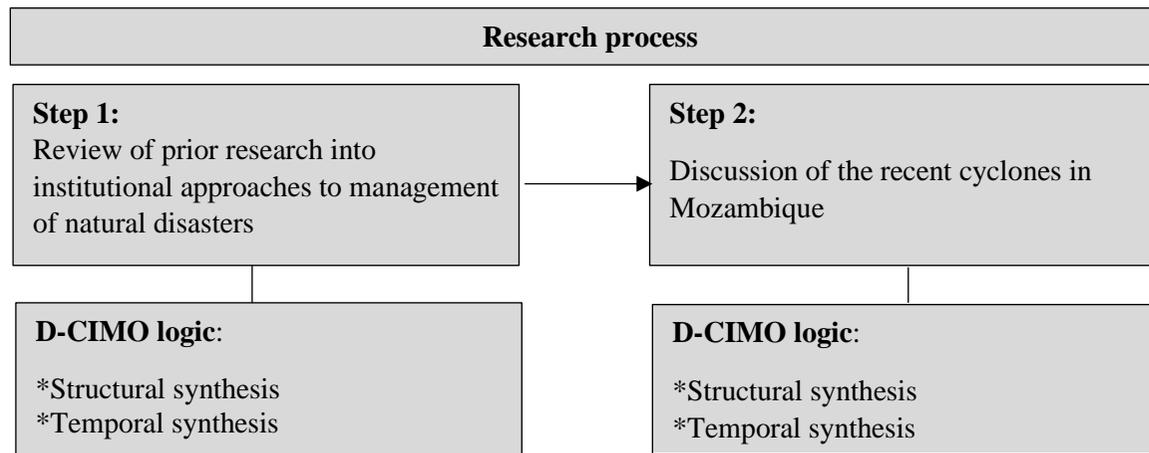
Source: Authors

Institutional approaches to management of natural disasters

In this part, perform Step 1 in our research process—review prior research in the area (Figure 2). We perform a D-CIMO logic synthesis of 46 studies to suggest key institutional approaches to management of natural disasters and how these approaches have evolved over time. Our review suggests three approaches: response-focused approach, mitigation-focused approach, and resilience-focused approach. The subsequent sections discuss these three approaches in greater detail. We begin each section with a context analysis. This cuts across a PEST framework comprising four dimensions: P-political, E-economic, S-social, and T-technological (Ho, 2014). Then, each section explores interventions and mechanisms whereby these interventions generate specific outcomes in management of natural disasters.

Response-focused approach

This approach focuses on post-hoc measures helping to respond to natural disasters when they have already occurred. Metaphorically, it may be viewed as a fire-fighting approach whose priority is to combat the current crisis (Wilhite, 2000). Being reactive in nature, this approach de-emphasizes anticipatory measures needed to prepare for natural disasters before they happen. Therefore, it does not centre on prevention of natural disasters and may show less preparedness for their mitigation.

The response-focused approach may be found in contexts where a high level of political uncertainty is coupled with severe resource scarcity. The political uncertainty and the economic scarcity impede allocation of critical resources for institutionalization of management of natural disasters; hence the lack of institutions (e.g. legislation, regulations, governance structures and intelligence systems) needed to address risks and effects of natural disasters (Pelling, 1999). In such contexts, a share of socio-economically disadvantaged populations is high suggesting the institutional primacy of poverty reduction over other objectives such as planning of natural disasters. This approach prevailed in an era of analogue technologies (until ca the early 2000s) presenting limited opportunities for sharing information and systematic learning about the diverse natural disasters (Turki *et al.,* 2019; Luscombe and Hassan, 1993).

Given its context, the response-focused approach is limited to relief operations and some basic post-disaster recovery as two desired outcomes. Its interventions are short-term as they are limited to the duration of a specific disaster. This approach involves limited learning. This is largely self-isomorphic and retrospective as it considers local practices and experiences from the past. This approach relies on a defensive mechanism with most of the managerial activity taking place mainly at the post-event stage. Table 1 summarises A D-CIMO-logic of the Response-Focused Institutional Approach to Management of Natural Disasters.

Table 1: A D-CIMO-logic of the Response-focused Institutional Approach to Management of Natural Disasters

Structural Synthesis				Temporal Synthesis
Context	**Interventions**	**Mechanisms**	**Outcomes**	**Dynamics**
P-political: Political uncertainty (e.g. due to political regimes and political divisions) is high and this impedes an institutional development. **E-economic**: Resource scarcity remains a serious problem when there is the need to allocate resources to respond to natural disasters. **S-social**: Socio-economic vulnerability is high at the pre-disaster stage and aggravates even further at the disaster- and post-disaster stages **T-technology**: Analogue era presents limited opportunities for information sharing	**Institutional focus** *short-term **Institutional type** *an occasional use of hard formal institutions which are embedded into other institutions whose primary mission and functions are not related to natural disasters **Learning** *Limited *Structural focus: self-isomorphic (e.g. learning from national disasters) *Temporal focus: retrospective (e.g. learning on a post-hoc basis) **Resources and capabilities** *resources are allocated on a post-hoc basis	**Reactive**: a mechanism taking form of reaction to the negative effects of a specific natural disaster when the disaster has already happened	**Reaction to the negative effects:** *relief operations at post-disaster stage	Managerial activity takes place mainly at the **post-event stage**.

Source: Authors

Mitigation-focused approach

This approach focuses on mitigation of effects of natural disasters when they have already happened (Di Baldassarre *et al.*, 2010). Like the first approach, it is an example of a defensive mechanism, and, as such, it does not allow preventing a natural disaster. However, unlike the first approach, it is anticipatory. By anticipating a natural disaster, this approach helps to foresee, prepare for, and mitigate the disaster's adverse effects.

The mitigation-focused approach may be found in contexts where there is a high level of political uncertainty; nonetheless, the institutionalization is in progress (Oh and Reuveny, 2010). Many critical resources remain scarce, but governments have learnt how to access them (Strömberg, 2007). This approach has emerged in an era of transition to digital technologies offering more opportunities for sharing information, learning, and gaining access to critical resources (Guo, 2010).

In this context, the approach produces mid-term interventions. These draw on ecosystems of institutions designated specifically for natural disasters. The management is no longer limited to post-event relief operations. Instead, it involves preparation for a possible disaster at the pre-event stage and mitigation of its effects at the event stage.

Learning is at the core of this approach. Structurally, it is no longer self-isomorphic; instead, isomorphic learning of overseas experiences becomes more important. This manifests in mimicking practices, engendering norms, and following regulations and laws that proved to be successful abroad and may be effective in the national context (Muttarak and Lutz, 2014). Temporarily, it complements retrospective accounts with prospective thinking (e.g. forecasting possible risks and their effects) (Muttarak and Lutz, 2014).

In this approach, managers rely on an adaptive mechanism—the one whose procedures are aimed at the reduction of possible negative impacts of a specific natural disaster that is near to happen or is happening (Hinkelet *et al.,* 2012; Shah, 2007). Table 2 summarises A D-CIMO-logic of the Mitigation-Focused Institutional Approach to Management of Natural Disasters.

Table 2: A D-CIMO-logic of the Mitigation-focused Institutional Approach to Management of Natural Disasters

Structural Synthesis				Temporal Synthesis
Context	**Interventions**	**Mechanisms**	**Outcomes**	**Dynamics**
P-political: Political risk remains high; nonetheless, the institutionalization is progress. **E-economic**: Resource scarcity remains a serious problem. However, the government secures access to some critical resources needed to cope with natural disasters. **S-social**: Social-economic vulnerability is high at the pre-disaster stage and aggravates even further at the disaster- and post-disaster stages. **T-technology**: Transition to digital era presents greater opportunities for information sharing.	**Institutional focus** *Medium term **Institutional type** *ecosystemic, with a series of institutions designated specifically for natural disasters. Multiple links are found between hard and soft institutions and between formal and informal institutions. **Learning** *Structural focus: self-isomorphic and isomorphic *Temporal focus: retrospective and prospective **Resources and capabilities** *Dynamic capabilities	**Adaptive**: a mechanism whose procedures are aimed at the reduction of possible negative impacts of a specific natural disaster that is near to happen or is happening.	**Mitigation of possible negative effects** *relief operations at pre-disaster, disaster, and post-disaster stages	Managerial activity spans pre-, event and post-event stages. The emphasis is on being prepared to act in agile manner at the **event-stage.**

Source: Authors

Resilience-focused approach

This approach focuses on prevention of natural disasters and their effects. Unlike the first two approaches, the prevention-focused approach allows avoiding natural disasters before they happen (Hallegatte et al., 2016). Like the mitigation-focused approach, it is anticipatory. However, its anticipatory function is more advanced. It helps to foresee, and to prevent the disaster and, if it still happens, to avoid its adverse impacts (Kuruppu and Willie, 2015).

The resilience-focused approach may be found in contexts where, despite a high level of political uncertainty, the institutionalization has progressed to the degree that matches the level of the institutional development in advanced economies (Boyd *et al*., 2015). The resource scarcity is no longer an issue because there is an easy access to critical resources from external sources.

This context marks a digital era with multiple opportunities for sharing information and resources (Amezquita-Sanchez *et al*., 2017). Examples of such opportunities include open education, open sources, open publications, open platforms—all making it possible to learn about, and to partner and pull together expertise, skills and capabilities to address, the existing and new types of natural disasters and associated with them risks (Sulzer, 2018).

In this context, the approach draws on interventions with a long-term impact. These interventions involve preparation for a possible disaster at the pre-event stage. Their primary focus is on meta learning—the one that goes beyond a national institutional ecosystem by spanning a meta-ecosystem of multiple institutions of various nations. This is possible due to the advances of digital technologies (Tambo, 2017).

In this approach, managers rely on a transformative mechanism—the one whose procedures are aimed at controlling a specific natural disaster that has been predicted for the nearest future (Manyena et al., 2019). This mechanism is enabled by higher-order dynamic capabilities residing in the institutional meta-ecosystems (Dubey *et al*., 2019a). These capabilities support agile changes in complex meta-ecosystems in preparation for a natural disaster (Mikulewicz and Taylor, 2020; Suifan *et al.,* 2020).). Table 3 summarises A D-CIMO-logic of the Resilience-Focused Institutional Approach to Management of Natural Disasters.

Table 3: A D-CIMO-logic of the Resilience-focused Institutional Approach to Management of Natural Disasters

Structural Synthesis				Temporal Synthesis
Context	**Interventions**	**Mechanisms**	**Outcomes**	**Dynamics**
P-political: Political uncertainty (e.g. due to political regimes and political divisions) is high and this impedes an institutional development. **E-economic**: Resource scarcity remains a serious problem when there is the need to allocate resources to respond to natural disasters. **S-social**: Social-economic disparities are high at the pre-disaster stage and aggravate even further at the disaster- and post-disaster stages **T-technology**: Analogue era presents limited opportunities for information sharing	**Institutional focus**: *long-term **Institutional type** *Meta-ecosystemic, with various institutional ecosystems capable of working together **Learning** *Meta-learning **Resources and capabilities** *Dynamic capabilities	**Transformative**: a mechanism comprising procedures helping to avoid future natural disasters and their negative impacts	**Prevention** *of a specific natural disaster *of negative effects of a natural disaster that is inevitable	Managerial activity spans pre-, event and post-event stages. It places a greater emphasis on **the pre-event stage**.

Source: Authors

Discussion

In the previous section, the structural synthesis of our D-CIMO logic has suggested three institutional approaches—response-focused approach, mitigation-focused approach, and resilience-focused approach—to the management of natural disasters. Now, we move on to the temporal synthesis. At this stage, our objective is to see whether, how and why changes in institutional structures factor changes in management of natural disasters.

Arguably, the change in institutional structures and their wider impacts is not equally driven by all the PEST—political, economic, social, and technological—factors (Tables 1, 2 and 3). Indeed, the contextual elements such as political, economic, and social factors have been rather similar across the three CIMO-structures. That is, political uncertainty, resource scarcity and social vulnerability perpetuated in the three approaches.

By contrast, the institutional structures seem to be more sensitive to the technological changes (Tables 1, 2, and 3). Specifically, the transition from the analogue era to the digital era in the late 1990s has played a big role in shaping institutions and their wider societal impacts. Indeed, the digital era has allowed sharing information and learning, and this trend has revealed opportunities for accessing institutional resources and capabilities which have not been available previously.

This change has affected the mechanisms underlying management of natural disasters. These evolved from the defensive mechanisms prioritizing operations at the post-event stage and event stage to the transformative mechanisms prioritizing the ability to avoid a natural disaster at the pre-event stage. The transformative mechanisms rely on agility of managerial action. This refers to fast and effective processes of information scanning, opportunity seizing and organizational transformation.

In sum, management of natural disasters appears to be a function of the technology-driven institutionalization. Theoretically, this suggests a shift in the institutional paradigm of management of natural disasters. This shift spans three stages in the technological development: the analogue era, the transition to the digital era, and the digital era. In the analogue era, the underlying paradigm was the response-focused approach to management of natural disasters. It shifted to the mitigation-focused approach during the transition to the digital era. The digital era marked the start of the resilience-focused approach. Table 4 visualizes the paradigmatic shift in the institutional approaches to management of natural disasters.

Table 4: A Paradigmatic Shift in the Institutional Approaches to Management of Natural Disasters

Structural Change				Temporal Change
Context	**Interventions**	**Mechanisms**	**Outcomes**	**Dynamics**
T-technology: Analogue Era → Digital Era	**Institutional focus**: short-term → long-term **Learning** limited learning → meta-learning **Resources and capabilities** resources → dynamic capabilities	**Defensive → Transformative**	**Combating effects → Avoiding events**	**Post-event stage → Pre-event stage**

Source: Authors

Lessons from Mozambique

This is Step 2 of our research process (Figure 2) where we discuss the recent natural disasters of Mozambique. Over the past three decades Mozambique has suffered several natural disasters including floods in 2000, 2007, 2010-2011, and 2015, droughts in 2003, 2004 and 2016, an earthquake in 2006, and fourteen cyclones since the end of the Mozambican civil war in 1992. In this discussion, we choose to focus on cyclones instead of floods, droughts, and earthquakes. The reason for this is that floods, droughts, and earthquakes do not happen as standalone events; rather they are often triggered by cyclones. Therefore, an understanding of cyclones may help to make sense of other related crises such as floods, droughts, and earthquakes, hence our focus on the cyclones. Table 5 presents a list of cyclones that affected Mozambique in the post-war period from 1992 through 2020.

The table reveals some institutional priorities in developing resilience in the face of cyclones in Mozambique. First, the Mozambican summer season has a higher risk of cyclones and, therefore, requires greater attention. It starts in the beginning of January and lasts until the end of April. This is the period when there is the need for greater preparedness to possible cyclones and their effects. This will help to address other related risks such as floods.

Second, there is the need for a closer collaboration with some countries. Until 2007, most cyclones emerged in Chagos Archipelago in the Indian Ocean. The more recent cyclones emerged in the area—Mozambique Channel—that is closer to Mozambique. As they moved from the Indian Ocean towards Mozambique, almost all the cyclones affected Madagascar suggesting the need for cooperative efforts between these two countries. Other immediate partners may be Zimbabwe, Malawi, Tanzania as well as some areas in the Indian Ocean including Seychelles, Comoros, and Mayotte.

Third, there is the need to develop a better understanding of factors underlying the frequency of cyclones. The between cyclone intervals ranged from 2 to 7 years. However, the two latest cyclones—Idai and Kenneth—happened with an unusually small interval of just one month challenging the existing system of management of natural disasters. Longer-term interventions such as research into and predictions of wider climate change trends may be essential here.

To date, the institutional development of management of natural disasters has not fully addressed these priorities. Our analysis suggests that much work needs to be done to enable faster and more effective responses to cyclones, and that, like many other low-income countries, Mozambique is still at the early stage of its digital transition and, therefore, shows only some features of the mitigation-focused approach.

Some of these features developed in the late 1990s. One of them was the beginning of institutionalization of management of natural disasters. A national institutional ecosystem

started to form following the creation of the INGC (Instituto Nacional de Gestão de Calamidades (Portuguese) and the National Disaster Management Institute (English)) by the Ministry of State Administration in 1999. Prior to that, the management of natural disasters function had been embedded into another institution—the Ministry of Foreign Affairs and Cooperation—whose role in natural disasters had been minimal as it had been limited to distributing external aid needed for relief operations.

Another feature became apparent in the mid-2000s. In that period, the lack of own resources and capabilities (e.g. an obsolescent equipment and poor training in relief operations in the Mozambique Defence Armed Forces and the Mozambique Air Force, and a deficit in financial means and human capital) stopped being an unsurmountable problem in the national management of natural disasters. The reason for that was that, by that time, the country had joined a wider institutional ecosystem for sharing information, joint learning, securing access to resources and capabilities with neighbouring countries and international agencies (Natural Disaster Management in Mozambique Collection, 2020)

Nonetheless, some features of the mitigation-focused approach in Mozambique have not fully developed. For example, despite the explicit emphasis on values of an adaptive culture, its mechanism remains largely reactive. Like other low-income countries (Reichel, 2018), Mozambique struggles to take advantage of its access to a wider institutional ecosystem and to reduce negative effects of natural disasters. For example, some members of local communities were reluctant to leave their houses and farms with animals to move to new safer areas (Goodman and Giles, 2019). Many did not realize the upcoming threats to the full extent (Goodman and Giles, 2019).

Arguably, moving from the reactive mechanism to the adaptive mechanism could make the mitigation-focused approach more effective. However, this transition requires linking institutions to dynamic capabilities enabling the adaptive mechanism. We suggest three ways of establishing this important link. First and foremost, policy makers will need to engage more actively into processes underlying dynamic capabilities residing in the existing institutional ecosystem. These processes include scanning new opportunities, seizing these opportunities and recalibrating boundaries of the institutional ecosystem (Teece *et al*., 1997).

Second, there is the need to complement hard institutions with soft institutions supporting mitigation interventions. In this case, possible measures may focus on engendering values and norms underlying decisions of policy makers and communities at the pre-event and event stages. Additionally, such measures may include developing simple rules underlying

behaviours of various groups during the natural disasters. Rules such as who, when, how and what is expected to do will help to reduce ambiguity among, to create cognitive short-cuts in, and to speed up responses of, individuals and organizations in the crisis period (Eisenhardt and Martin, 2000).

Third, it is critical to supplement formal institutions with informal institutions (Goodman and Giles, 2019). Overreliance on formal institutions may be a sign of coercive top-down governance which often triggers resistance, decelerates local response and, therefore, is ineffective in working with local communities in the Mozambican context. However, introducing elements of bottom-up governance—informal institutions—into the institutional ecosystem may help to develop greater sensitivity to the needs and priorities of local communities; hence the better cooperation of, and more agility in helping to, the local population during disasters.

Conclusions

Management of natural disasters relies on strong institutions. In this chapter, we contribute by integrating the generic institutional approaches underlying management of natural disasters in developing economies. Our D-CIMO synthesis of prior research suggests three generic approaches: response-focused approach, mitigation-focused approach, and resilience-focused approach.

The formation of these approaches has been driven by changes in the political, economic, and social contexts in developing economies. Yet, we argue that the technological change has been the most decisive force as it shifted the overall institutional paradigm of management of natural disasters. Specifically, the transition from the analogue era to the digital era has made it possible for governments to move to approaches with greater control over natural disasters. In many instances, the initial digitalization triggered the transfer from response-focused approaches to mitigation-focused approaches. Likewise, the more recent advances in digital technologies have created opportunities for the adoption of resilience-focused approaches.

This shift is evident in Mozambique. Its integration of digital innovations has stimulated the transition from a response-focused approach to a mitigation-focused approach. This institutional change has made the national management of natural disasters more effective. Nonetheless, the adaptive mechanism of this approach has not fully developed in Mozambique. We suggest taking several steps in resolving this issue. First, policy makers will need to engage more actively into processes underlying dynamic capabilities residing in the existing institutional ecosystem. Second, there is the need to complement hard institutions with soft institutions supporting mitigation interventions. Finally, it is critical to supplement formal institutions with informal institutions.

Table 5: Cyclones in Mozambique from 1992 through 2020

Name	Year	Season	Origin	Impact
Nadia	1994	16th March – 1st April	Chagos Archipelago in the Indian Ocean	**Category 4/SSWHS** Cyclone Nadia affected four Mozambican provinces. Its greater impact was in the northern province—Nampula—where it destroyed 85% of houses, left 1.5 million people homeless and caused 300 deaths. Its wind destroyed energy supplied networks and caused power outages. It hit water supply systems leaving multiple areas without water. The cyclone damaged crops, especially cashew crops. Apart from Mozambique, the cyclone affected Madagascar.
Bonita	1996	3rd -20th January	Chagos Archipelago in the Indian Ocean	**Category 4/SSWHS** Bonita affected the Mozambique's centre (Zambezia) and north (Nampula and Cabo Delgado) by destroying around 400 houses, damaging electricity supply systems and killing 17 people in the city of Quelimane and caused floods of the River Buzy. Apart from Mozambique, the cyclone affected Madagascar and Zimbabwe.
Leone-Eline	2000	1st-29th February	Near Christmas Island, an Australian external territory in the Indian Ocean	**Category 4/SSWHS** The cyclone killed 700 people, caused floods and its strong winds destroyed houses leaving about 463,000 people displaced or homeless. Of these, 46,000 were children five years old or younger. The strongest damage was recorded in central Mozambique, especially to Chokwe areas. Apart from Mozambique, the cyclone affected Madagascar, Zimbabwe, and Malawi.
Hudah	2000	22nd March- 9th April	Chagos Archipelago in the Indian Ocean	**Category 4/SSWHS** In Mozambique, the cyclone resulted in heavy rainfalls in Quelimane with subsequent flooding and destruction of some infrastructures and houses. Yet, this cyclone did not have the same devastating effect as the preceding cyclone Leone-Eline. Another affected country was Madagascar.
Japhet	2003	25th February-5th March	Mozambique Channel	**Category 4/SSWHS** The cyclone killed 17 people and damaged 25,000 houses in the upper south areas (Inhambane) and in the centre (Sofala). The Inhambane was affected the worst. There the cyclone left about 23,000 people homeless. Other countries affected by the cyclone were Madagascar (heavy rains but no damage) and Zimbabwe (heavy rains caused an increase in malaria cases).

Name	Year	Season	Origin	Impact
Delfina	2002/ 2003	30th December–1st January	Mozambique Channel	**Category Tropical Storm/SSWH** Delfina affected the centre (Zambezia) and the north (Nampula) of Mozambique by causing floods which killed 47 people and by devastating 18.000 houses leaving 133.000 people displaced, transport network, health facilities and schools. It destroyed over 2000 ha of crops and caused food supply shortages. It triggered an increase in post-flood diseases including malaria and cholera. The storm also caused devastating effects on Malawi.
Favio	2007	11th -23rd February	Chagos Archipelago	**Category 4 Tropical Cyclone/SSWH** The cyclone killed 10 and injured 100 people. It damaged 130000 houses leaving 33000 people displaced and affecting 160000 people in various ways. It destroyed crops in Vilankulos, Inhassoro, Govuro and Masinga in the Province of Inhambane. The cyclone also affected Madagascar, Tanzania, Zimbabwe and Malawi
Jockwe	2007	2nd-16th March	Chagos Archipelago	**Category 3 Tropical Cyclone/SSWH** The cyclone affected the central province of Zambezia and the northern province of Nampula (especially Angoche). It killed 6 people and left 55000 people displaced. In total, it affected 200000 people. It destroyed infrastructures (e.g. bridges, transport connections, schools and medical units). It destroyed farms killing 508 animals and damaging crops (2 million of cashew plants. Madagascar was another country affected by this cyclone.
Funso	2012	17th-29th January	Comoros Archipelago in Mozambique Channel	**Category 4 Tropical Cyclone/SSWH** The cyclones strong winds affected three million people, most of them being from the Province of Zambezia. It destroyed 1,610 houses and damaged water and drainage systems causing water supply and sanitation problems. Malawi was another country affected by the cyclone.
Haruna	2013	14th-28th February	Mozambique Channel	**Category 3 Tropical Cyclone/SSWH** The cyclone affected Mozambique, but the major impact was on Madagascar.
Idai	2019	4th – 21st March	Mozambique Channel	**Category 3 Tropical Cyclone/SSWH** The cyclone affected mainly the centre of Mozambique having the greatest impact in the city of Beira. It killed 602 and injured 1,641 people, inflicting around US$773 million in damage. It destroyed 111,163 homes, damaged 112,735 houses and its flooding destroyed 15,784 structures. In total, more than 1.85 million people were

Name	Year	Season	Origin	Impact
				affected by the cyclone. The cyclone destroyed 711,000 ha (1,760,000 acres) of crops causing a high risk of famine to the centre of Mozambique and the wider country. Apart from Mozambique, the cyclone affected other countries including northern Madagascar, Malawi, and Zimbabwe.
Kenneth	2019	21st – 29th April	Comoros Island, north of Madagascar	**Category 4 Tropical Cyclone/SSWH** The cyclone had some impact in the centre of Mozambique. Yet, it hit the hardest the northern provinces of Niassa, Nampula and Cabo Delgado. Kenneth killed 45 people in Mozambique. The damage was estimated at $100 million. Other affected areas were Seychelles, Comoros, Mayotte, northern Madagascar, southern Tanzania, and Malawi.

Source: Authors

References

Amezquita-Sanchez, J. P., Valtierra-Rodriguez, M., & Adeli, H. (2017). Current efforts for prediction and assessment of natural disasters: Earthquakes, tsunamis, volcanic eruptions, hurricanes, tornados, and floods. *Scientia Iranica*, 24(6), 2645-2664.

Amit, S. N. K. B., Shiraishi, S., Inoshita, T., & Aoki, Y. (2016). Analysis of satellite images for disaster detection. *IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, July, 5189-5192

Antoniou, V., & Potsiou, C. (2020). A Deep Learning Method to Accelerate the Disaster Response Process. *Remote Sensing*, 12(3), 544-554.

Boustan, L. P., Kahn, M. E., Rhode, P. W., & Yanguas, M. L. (2020). The effect of natural disasters on economic activity in US counties: A century of data. *Journal of Urban Economics*, 103-257.

Boyd, E., Nykvist, B., Borgström, S., & Stacewicz, I. A. (2015). Anticipatory governance for social-ecological resilience. *Ambio*, 44(1), 149-161.

Brassard, C., Giles, D. W., & Howitt, A. M. (2016*). Natural Disaster Management in the Asia-Pacific*. Springer Verlag, Japan.

Breckner, M., Englmaier, F., Stowasser, T., & Sunde, U. (2016). Resilience to natural disasters—Insurance penetration, institutions, and disaster types. *Economics Letters*, 148, 106-110.

Bubeck, P., Kreibich, H., Penning-Rowsell, E. C., Botzen, W. J. W., de Moel, H., & Klijn, F. (2017). Explaining differences in flood management approaches in Europe and in the USA–a comparative analysis. *Journal of Flood Risk Management*, 10(4), 436-445.

Caruso, G. D. (2017). The legacy of natural disasters: The intergenerational impact of 100 years of disasters in Latin America. *Journal of Development Economics*, 127, 209-233.

Choudhury, M. U. I., Uddin, M. S., & Haque, C. E. (2019). "Nature brings us extreme events, some people cause us prolonged sufferings": the role of good governance in building community resilience to natural disasters in Bangladesh. *Journal of Environmental Planning and Management*, 62(10), 1761-1781.

Correa, E. (2011). *Preventive Resettlement of Populations at Risk of Disaster. Experience from Latin America*. The World Bank and GFDRR. Washington DC.

De Mel, S., McKenzie, D., & Woodruff, C. (2012). Enterprise recovery following natural disasters. *The Economic Journal*, 122(559), 64-91.

Denyer, D., Tranfield, D., & Van Aken, J. E. (2008). Developing design propositions through research synthesis. *Organization studies*, 29(3), 393-413.

Di Baldassarre, G., Montanari, A., Lins, H., Koutsoyiannis, D., Brandimarte, L., & Blöschl, G. (2010). Flood fatalities in Africa: from diagnosis to mitigation. *Geophysical Research Letters*, *37*(22).

Dominey-Howes, D. (2015) Are natural disasters on the rise? The Conversation. Available at: https://theconversation.com/explainer-are-natural-disasters-on-the-rise-39232 Accessed on 15th July 2020.

Doyle, C., Weber, S., Ho, J. C., Schwarz, B., Glinskis, E., Landuyt, L., & Tellman, B. (2019). Leveraging Earth Observations for Decision Support During Flood Disaster Prevention, Response, and Recovery. AGUFM, 2019, PA31B-04.

Dubey, R., Gunasekaran, A., & Papadopoulos, T. (2019). Disaster relief operations: past, present and future. *Annals of Operations Research*, 283(1-2), 1-8.

Dubey, R., Gunasekaran, A., Childe, S. J., Blome, C., & Papadopoulos, T. (2019a). Big data and predictive analytics and manufacturing performance: integrating institutional theory, resource-based view and big data culture. *British Journal of Management*, 30(2), 341-361.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they? *Strategic Management Journal,* 21(10-11), 1105-1121.

Gilbert, R., & Kreimer, A. (1999). Learning from the world bank's experience of natural disaster related assistance. *Disaster Management Facility: Part 2,* 1-72.

Goodman, J. and Giles, C. (2019) Cyclone Idai: How prepared was southern Africa? Available at: https://www.bbc.co.uk/news/world-africa-47639686 Accessed on 14th July 2020.

Guo, H. (2010). Understanding global natural disasters and the role of earth observation. *International Journal of Digital Earth*, 3(3), 221-230.

Ha, K. M. (2019). A mechanism of disaster management in Korea: typhoons accompanied by flooding. *Heliyon*, 5(8), e-02181.

Hallegatte, S., Vogt-Schilb, A., Bangalore, M., & Rozenberg, J. (2016). Unbreakable: building the resilience of the poor in the face of natural disasters. *World Bank Publications*.

Heteren, A., Hirt, M. and Veken, L. (2020) Natural disasters are increasing in frequency and ferocity. Here's how AI can come to the rescue. *The World Economic Forum*. Available at: https://www.weforum.org/agenda/2020/01/natural-disasters-resilience-relief-artificial-intelligence-ai-mckinsey/ . Accessed on: 15th July 2020.

Hinkel, J., Brown, S., Exner, L., Nicholls, R. J., Vafeidis, A. T., & Kebede, A. S. (2012). Sea-level rise impacts on Africa and the effects of mitigation and adaptation: an application of DIVA. *Regional Environmental Change*, 12(1), 207-224.

Ho, J. K. K. (2014). Formulation of a systemic PEST analysis for strategic analysis. *European Academic Research*, 2(5), 6478-6492.

John, A. (2020) D-CIMO-logic: a new methodology for research synthesis. Working Paper. March, 1-23.

Johnson, B. R., Connolly, E., & Carter, T. S. (2011). Corporate social responsibility: The role of Fortune 100 companies in domestic and international natural disasters. *Corporate Social Responsibility and Environmental Management*, 18(6), 352-369.

Kahn, M. E. (2005). The death toll from natural disasters: the role of income, geography, and institutions. *Review of Economics and Statistics*, 87(2), 271-284.

Karlaftis, M. G., Kepaptsoglou, K. L., & Lambropoulos, S. (2007). Fund allocation for transportation network recovery following natural disasters. *Journal of Urban Planning and Development*, 133(1), 82-89.

Kelman, I. (2019). Axioms and actions for preventing disasters. *Progress in Disaster Science*, 2.

Kermanshachi, S., Bergstrand, K., & Rouhanizadeh, B. (2019). Identifying, Weighting and Causality Modeling of Social and Economic Barriers to Rapid Infrastructure Recovery from Natural Disasters: A Study of Hurricanes Harvey, Irma and Maria (No. CTEDD: 018-05 SG).

Knez, I., Butler, A., Sang, Å. O., Ångman, E., Sarlöv-Herlin, I., & Åkerskog, A. (2018). Before and after a natural disaster: Disruption in emotion component of place-identity and wellbeing. *Journal of Environmental Psychology*, 55, 11-17.

Kuruppu, N., & Willie, R. (2015). Barriers to reducing climate enhanced disaster risks in Least Developed Country-Small Islands through anticipatory adaptation. *Weather and Climate Extremes*, 7, 72-83.

Liu, D. (2019). Typhoon/Hurricane/Tropical Cyclone disasters: prediction, prevention and mitigation. *Journal of Geoscience and Environment Protection*, 7(05), 26-32.

Luscombe, B. W., & Hassan, H. M. (1993). Applying remote sensing technologies to natural disaster risk management: implications for developmental investments. *Acta Astronautica*, *29*(10-11), 871-876.

Manyena, B., Machingura, F., & O'Keefe, P. (2019). Disaster Resilience Integrated Framework for Transformation (DRIFT): A new approach to theorising and operationalising resilience. *World Development*, 123, 104587.

Mikulewicz, M., & Taylor, M. (2020). Getting the resilience right: Climate change and development policy in the 'African age'. *New Political Economy*, 25(4), 626-641.

Murray, M., & Watson, P. K. (2019). Adoption of natural disaster preparedness and risk reduction measures by business organisations in Small Island Developing States-A Caribbean case study. *International Journal of Disaster Risk Reduction*, 39, 101-115.

Muttarak, R., & Lutz, W. (2014). Is education a key to reducing vulnerability to natural disasters and hence unavoidable climate change? *Ecology and Society*, 19(1), 1-12.

Natural Disaster Management in Mozambique Collection (2020). *Collection of the Humanitarian Library.* Available at: https://www.humanitarianlibrary.org/collection/natural-disaster-management-mozambique Accessed on: 14th July 2020.

Navrud, S., & Magnussen, K. (2013). Valuing the impacts of natural disasters and the economic benefits of preventing them. *The Economic Impacts of Natural Disasters*. Oxford University Press, New York, 57-79.

Oh, C. H., & Reuveny, R. (2010). Climatic natural disasters, political risk, and international trade. *Global Environmental Change*, 20(2), 243-254.

Pelling, M. (1999). The political ecology of flood hazard in urban Guyana. Geoforum, 30(3), 249-261.

Raschky, P. A. (2008). Institutions and the losses from natural disasters. *Natural Hazards and Earth System Sciences*, 8(4), 627-634.

Rayamajhee, V., & Bohara, A. K. (2019). Natural Disaster Damages and Their Link to Coping Strategy Choices: Field Survey Findings from Post-Earthquake Nepal. Journal of International Development, 31(4), 336-343.

Reichel, C. (2018). Why people choose to stay in areas vulnerable to natural disasters. Journalist's Resource. Available at:

https://journalistsresource.org/studies/environment/climate-change/relocation-climate-change-flooding-research/ Accessed on 14th July 2020.

Shah, D. (2007). Sense Respond and Adapt: An Architecture to Mitigate Natural Disasters (Doctoral dissertation, University of Washington).

Shah, A. A., Shaw, R., Ye, J., Abid, M., Amir, S. M., Pervez, A. K., & Naz, S. (2019). Current capacities, preparedness and needs of local institutions in dealing with disaster risk reduction in Khyber Pakhtunkhwa, Pakistan. *International Journal of Disaster Risk Reduction*, 34, 165-172.

Sinha, A. (1999). Relief administration and capacity building for coping mechanism towards disaster reduction. In Special Issue: World Disaster Reduction Day (pp. 9-12). UN.

International Decade for Natural Disaster Reduction (IDNDR); Housing and Urban Devolpment Corporation (HUDCO); Human Settelement Management Institute (HSMI).

Strömberg, D. (2007). Natural disasters, economic development, and humanitarian aid. *Journal of Economic perspectives*, 21(3), 199-222.

Suifan, T., Saa'da, R., Alazab, M., Sweis, R., Abdallah, A., & Alhyari, S. (2020). Quality of Information Sharing, Agility, and Sustainability of Humanitarian Aid Supply Chains: An Empirical Investigation. *International Journal of Supply Chain Management*, 9(5), 1-23.

Sulzer, W. (2018). Natural Hazards and Earth Observation. *Satellite-Based Earth Observation*, 225-233, Springer, Cham.

System (2020). Definition of 'System'. Definitions and Meanings. *Business Dictionary*. Available at: http://www.businessdictionary.com/definition/system.html Accessed on 15th July 2020.

Tambo, E. (2017). Improving disaster risk reduction preparedness and resilience approaches in emergency response interventions in African Countries. *International Journal of Public Health*, 6(2), 183-191.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533.

Turki, S., Martin, S., Renault, S., Turczi, V., & Alletti, M. (2019). From a Natural Disaster to Digital Transformation. *ECDG 19th European Conference on Digital Government*. Academic Conferences and Publishing Limited.

Yang, B., & Jahan, I. (2018). Comprehensive assessment for post-disaster recovery process in a tourist town. Sustainability, 10(6), 1842.

Wagner, M., Chhetri, N., & Sturm, M. (2014). Adaptive capacity in light of Hurricane Sandy: The need for policy engagement. *Applied Geography*, 50, 15-23.

WHO (1971). Natural Events. *Guide to Sanitation in Natural Disasters of the World Health Organization*. Available at:

https://www.who.int/environmental_health_emergencies/natural_events/en/ Accessed on: 15th July 2020.

Wilhite, D. A. (2000). Drought preparedness and response in the context of Sub-Saharan Africa. *Journal of Contingencies and Crisis Management*, 8(2), 81-92.

Zhang, L., & Li, L. (2019). People-oriented emergency response mechanism—An example of the emergency work when typhoon Meranti stroked Xiamen. *International Journal of Disaster Risk Reduction*, 38, 101-185.