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Disasters as opportunities for social change: Using the multi-level perspective to consider the barriers to disaster-related transitions

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ABSTRACT

We examine the suitability of using the multi-level perspective to describe disaster-related transitions and their barriers in an institutional environment that expects disaster responders, such as government agencies, to adhere to the increasingly established principles of disaster risk reduction. We created a process-tracing test based on disaster and transition literature and applied it to two cases: Cyclone Nargis and Hurricane Katrina. In applying this test we found that multi-level perspective is a valid way to describe disaster-related transitions. We also determined that both the concepts of build back better and disaster risk reduction influenced the transitions. Moreover, a lack of resources and a strong government desire for control presented obstacles to transition. These disaster-related transitions have implications for policy considerations. Knowledge from this article can inform future studies on disaster response and recovery.

1. Introduction

Disasters[1] are more than the environment causing immediate death and destruction; they are also the result of societal factors which lead some people more vulnerable than others. However, since the development of the concept of build back better[2] after the Asian Tsunami in 2004 [18] and the Hyogo Framework for Action[3] [84] in 2005, disaster responses have sought to do more than rebuild what was before, but also to address the social factors that caused the vulnerability in the first place. Those that are attempting to reduce this vulnerability, are attempting to do so through a purposeful transition from the society's pre-disaster state of vulnerability to an improved post-transition state of vulnerability, thus reducing that society's likelihood of experiencing similar disasters in the future.

After a disaster, often a great deal of disaster aid flows into the affected region. The attention of both the populace and politicians is focused on reducing vulnerability [33]. This post-disaster period is an opportune time for disaster risk reduction activities [33]. In the past, many have focused on increasing physical resilience such as building earthquake resistance housing or relocating houses out of a flood zone. However, improving social resilience, in addition to physical resilience, has become an increasing focus of disaster risk reduction activities [72,83].

Yet, there are a myriad of difficulties associated with purposeful transitions. Barriers often prevent a transition to reduced vulnerability and as a result the community is left vulnerable to the increased likelihood of disasters associated with climate change. To understand both the dynamics of transitions and the barriers that prevent them, we will use the multi-level perspective (a three tiered perspective used to understand historic and potential sustainability transitions, further described in Section 2). The multi-level perspective is useful for this purpose because it allows us to see the post-disaster transition resonate through the levels of society and allows us to describe the interlocking steps that take the society from the pre-disaster state of vulnerability to the post-disaster state of vulnerability. This article demonstrates that there can be post-disaster transitions to reduced vulnerability. It also demonstrates that using the multi-level perspective allows us to amalgamate the different societal levels of disaster response into a single conceptualization. This allows for the suggestion of which policies may help to overcome these barriers and may allow for the disaster community to move forward in finding solutions so that the promises of disaster risk reduction can be achieved.

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[1] According to the United Nations a disaster is "[a] serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources" [78]. This definition therefore excludes small scale everyday emergencies such as a house fire, as well as purely environmental events that do not affect human settlements.

[2] The principle of 'build back better' can be summed up as the aim "to use the opportunity of a disaster response to leave societies improved, not just restored" [18].

[3] The Hyogo Framework was designed as a framework to help reduce societal vulnerabilits to disasters [84].

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We will use process-tracing to confirm the presence of transitions in post-disaster settings. Additionally, we will examine the applicability of the multi-level perspective to disaster-related transitions and attempt to understand the barriers to implementing effective disaster risk reduction policies.

The take on the multi-level perspective presented here will look to present disaster response and recovery in a different light. This allows for the dynamic interplay between the disaster responses originating from the different levels of society. It will test that the multi-level perspective is a valid way to describe how a disaster can resonate through and transform society and it will answer the following key questions:

1. Can the multi-level perspective be used to describe a disaster-related transition and use its societal scales to describe how the interaction between the social levels leads to a transition? How would this transition occur?
2. Have disaster-related transitions been affected by the new institutional environment developed after the Hyogo Framework for Action and the concept of build back better?
3. What are the policy implications of the opportunity for vulnerability-reducing disaster-related transitions?
4. Are there barriers to disaster-related transitions? Can the multi-level perspective shed light on those barriers?
5. What lessons can disaster and transitions scholars learn from each other?

This article expands the use of the multi-level perspective to disaster-related transitions which, to the best of our knowledge, is the first time this has been done. To accomplish this, the article is structured as followed: firstly, a post-disaster transition will be conceptualized using both disaster and transition literature. Second, we will cover the methodology used to test the validity of this conceptualization. This section points to the use of the recent developments in process-tracing, applying it to test for the presence of a transition and the applicability of the multi-level perspective to disaster-related transitions. Thirdly, a narrative of the two case studies including the evidence for each of the conceptualized transition steps are described in the results section as well as the barriers to the transitions. Fourthly, we will answer our key research questions as well as discuss their implications. Lastly, we will conclude with the importance of the findings and discuss how they can spur further research.

2. Conceptualizing disasters using the multi-level perspective

The conceptualization for this article is built upon previous research on transitions and disasters. A transition is a "long-term, fundamental change in societal subsystems and are seen as encompassing co-evolutionary and mutually reinforcing processes in the economic, technological, institutional and social-cultural domains" [30]. Extreme events like disasters not only spark transitions, but also accelerate them [60].

The concept of transition has its origins in the 19th century and has been used in diverse fields such as demography, environmental biology, and to study former communist countries moving towards a free market system [39]. Transition studies research originated from the Netherlands in the early 2000s and has primarily been carried out by Dutch researchers [8]. The multi-level perspective,[4] one of the leading frameworks for considering transitions [47], is designed to explain and narrate socio-technological transitions [23,26]. At the core of the multi-level perspective are three levels of society: niche, regime, and landscape. The niche (or micro) level is where radical new innovations[5] arise [26] from protected spaces [36,47]. The success of a niche is related to ongoing issues within the current regime [36]. The regime level (or meso) level consists of "… a coherent configuration of technological, institutional, economic, social, cognitive and physical elements and actors with individual goals beliefs or values" [30]. The last level, the landscape (or macro) level, can be described as the broad societal framework to the transition including the historic, environmental, and cultural backdrop [27,60]. Each level will be further described in the relation to our conceptualization in the text that follows.

Building upon the disaster and transitions literature described below, we created Fig. 1 which depicts a disaster-related transition. The letters and numbers in brackets in Fig. 1 and the text below correspond to the steps in the process-tracing test (Fig. 2) described later in this article as well as the empirical evidence of each step in the cases that follow. The meaning of each of the symbols is further explained below and in the methods section.

Our conceptualization makes use of vocabulary from both transition and disaster literature. Transition studies developed from fields such as political science, evolutionary economics, technology studies sociology, institutional theory, and innovation studies [36,24,22] and thus the concepts and vocabulary used in transition literature often reflects those origins. Moreover, when it comes to the disaster vocabulary used in the conceptualization, it is important to note that both disasters literature and climate change literature use a different vocabulary to describe disaster events and there is little agreement upon the various definitions [6]. However, to be as clear as possible, we have chosen to use the vocabulary used in disaster literature in this conceptualization and to use the definitions set out by the United Nations [78]. Thus, our understanding of vulnerability follows the internal definition of vulnerability often used in disaster literature, as opposed to the external definition found in the climate change literature [14].

A disaster-related transition begins at the landscape level, which is generally slow and resistant to adapting to changes [60]. This is where a community's vulnerability[6] **[X1]** and environmental hazard[7] **[X2]** act in the "pre-development phase" [60] of the transition, or the slow progressing period before the acceleration sparked by the disaster event. Pre-disaster vulnerability is a cause because the level of vulnerability before the disaster

[4] The multi-level perspective described here differs from the concept of multi-level governance [31] in that the latter focuses levels of government such as whereas the multi-level perspective focuses more broadly on society including not only government, but also companies, technology, the environment, etc. Because of its broad focus on society, the multi-level perspective is more appropriate for studying the overall transition in society to lower vulnerability.

[5] We borrow the concept of innovation from the multi-level perspective literature where it has been defined as "radical new technologies" and "novelties" that develop in niche spaces [23]. The concept of innovation within multi-level perspective literature is informed by the inclusion on concepts from innovation studies [24,63]. Sources for further discussions on innovation include Markard and Truffer [47], Smith et al. [63] and Van den Bergh et al. [79].

[6] The physical, social, economic, and environmental factors which increase the likelihood of that a hazard will lead to a disaster event [78]. Many social factors contribute to a community's vulnerability such as demographic makeup of the community such as sex, age, minorities, marginalized groups such as illegal immigrants, as well as other factors that contribute to social and economic capital [72]. Moreover, "[l]imited rural livelihoods, poor urban and local governance, ecosystem decline, gender inequality and limited access to education, credit and financial systems" [33] are especially important in increasing vulnerability. Programs or structures that allow people to better manage their risk, such as social safety nets, reduce vulnerability [85].

[7] According to the United Nations a hazard is "[a] potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation" [78]. A hazard can only become a disaster when it comes in contact with vulnerable people, and thus, for example, a flood in an uninhabited forest is not a disaster.

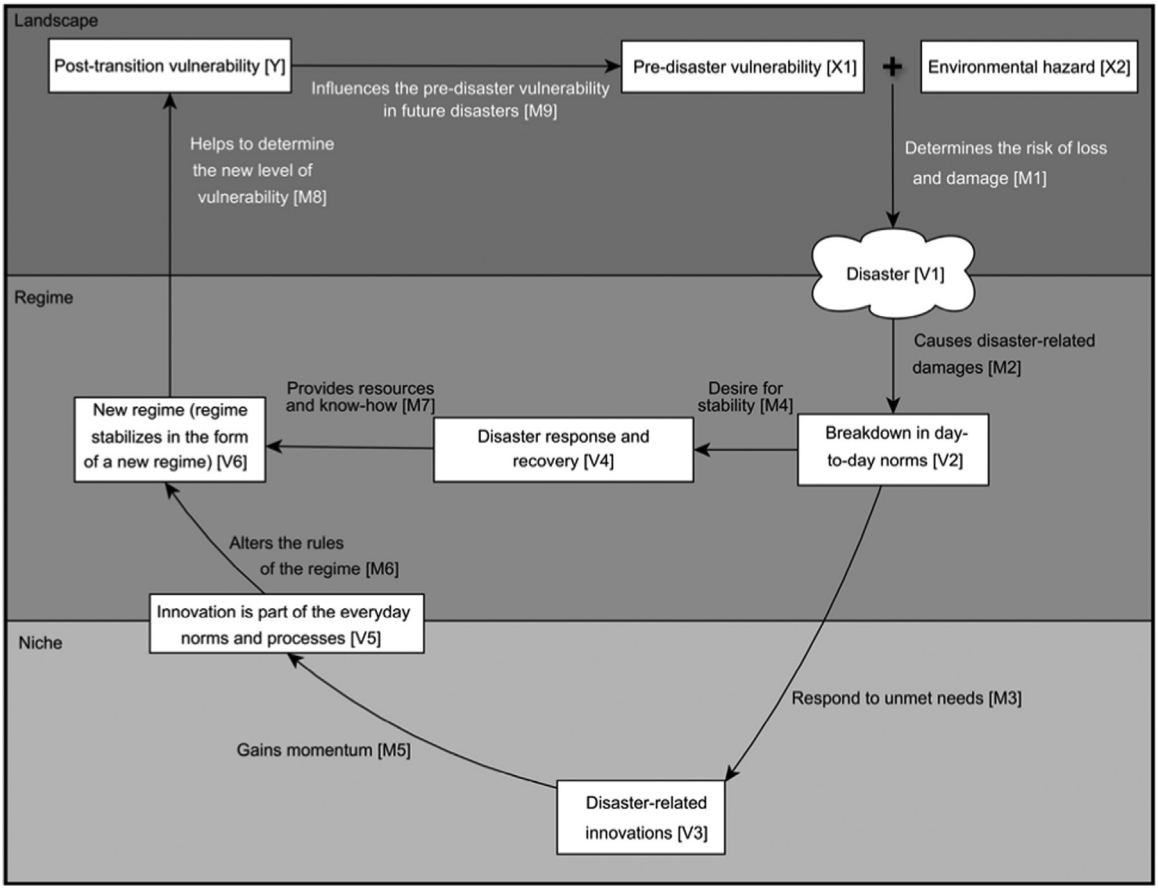

Fig. 1. A disaster-related transition from the multi-level perspective beginning with pre-disaster vulnerability and environment hazard moving clockwise.

directly affects if there will be a disaster [78].

Environmental hazard is the second cause. This is because vulnerability is not enough to cause a disaster alone, instead disasters and disaster-related transitions can only occur when an environmental hazard is also present. The environmental hazard, which could be, for example an earthquake or flood, provides the opportunity for a disaster. While one could trace vulnerability and environmental hazard back to their causes, both can have a multitude of different causes beyond the scope of this article (for a detailed breakdown of indicators and causes of vulnerability and hazard see [6]). Implicit in this argument is that there must be vulnerability to environmental hazards in the pre-disaster state in order for the transition to commence. Combined vulnerability and hazard make up the risk of loss and damage[8] [7] **[M1]**.

The vulnerability and environmental hazard can lead to a disaster event which will shock the system **[V1]**, which occurs at both the landscape and the regime level. The regime consists of ongoing rules, practices, and beliefs [27,60] which are linked so that changing one rule alters the others [24]. Importantly the "expression, shaping and meeting of needs is an emergent feature of the interaction of many actors in the regime" [30]. Within the context of a disaster transition it is the level of the national government as well as national and international organizations that send money and aid to the disaster affected region. While regimes can act as a barrier to niche innovations, especially in the early stages of a transition, as a transition continues it may become a facilitator [60]. The regime may help to achieve the transition through promoting disaster risk reduction activities during the disaster response[9] and recovery.[10] Disasters cause damage through processes such as damaging houses or infrastructure **[M2]** which leads to a breakdown in the day to day roles and process of the community and thus normal day-to-day- life **[V2]**. This, for example, could mean that damage to the road infrastructure makes it difficult for individuals to get to places of employment, be productive, and receive an income. Damaged roads will make it difficult for food to get to into the local markets and for people to obtain the necessary provisions.

However, regimes are self-stabilizing [30] and regime actors seek to restore stability after a disaster and seek the return to the pre-disaster norms **[M4].** This leads regime actors such as the government to disaster response and recovery efforts **[V4]** such as repairing infrastructure or handing out meals. It is the disaster response and recovery that provides the both the resources and the know-how **[M7]** for the regime to begin to recover from the damage caused by the disaster and begin to restore day-to-day functions. This, for example, could be tarps that allow people to return to their homes.

[8] A higher level of pre-disaster vulnerability increases the likelihood of damages. For example, the more people living on a flood plain, the more likely damage will occur and a higher amount of damage when a flood happens. Moreover, the greater the environmental hazard the more likely damage will occur and a higher amount of damage. For example, a larger flood is more likely to cause damage than a smaller flood.

[9] We use the United Nations definition of response as "[t]he provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short- term, or protracted duration" [78].

[10] We use the definition of recovery put out by the United Nations: "Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk" [78].

Meanwhile, the niche level responds to the unmet needs[11] that result from the disruption in the regime **[M3].** This could be, for example, someone helping a disaster victim locate a needed phone number to access disaster services. Some unmet needs are addressed through new and innovative ideas and practices; these are the disaster-related innovations **[V3]**. Using our example, the helper than could realize that this is a problem and create a central webpage on which all of the victims of the disaster can look up the phone numbers for disaster services.

This process occurs at the niche level, which is the level where a small group of actors or individuals develop the innovative concepts [27,60] and "offer an opportunity to experiment with new practices and norms that may then become accepted more generally in society" [52]. In the context of disasters, niches can be local non-profit organizations, local government, and local branches of national (or international) organizations. These niches can be pre-existing or they can form post-disaster. Niches do not have to be present in the disaster affected area, for example a community group raising money to send for disaster relief in another country. A disaster-related innovation need not be an innovation that specifically deals with disasters, but the innovation is related to the disaster which is ongoing or had recently occurred. However, as we are interested in disaster risk reduction we will be looking for innovations that affect vulnerability.

Some niche innovations are able to gain traction or momentum **[M5]**. By this we mean that the idea or concept of the innovation diffuses or spreads. This could, for example, occur through an organization with the innovation growing or the innovation being picked up by other organizations. While the direction of the innovation is not exclusively determined by it, innovations are influenced by both the regime and landscape [24]. The influence from the regime is often through disaster response and recovery efforts, which can coordinate (through monetary assistance, legal requirements, guidelines, etc.) niches. The landscape influences the niches through pressures and norms. These more mature niches may or may not consist of the same group that originated the innovation.

If the niche innovation is able to gain enough momentum the regime will adopt it [**V5]** and it will become part of the everyday norms. The regime is normally resistant to niche innovations [25] and prefers slow change, and it is the destabilization in the regime (in this conceptualization caused by the disaster) that sometimes allows for the niche innovations to break through [26] and radically alter the regime. If the regime is strong enough, it will resist the innovations; however, a sufficiently weakened regime allows the innovations opportunity to become incorporated.

If the innovation is able to break through, the regime adopts the niche innovation through adopting laws, changing its practices, or changing regime actors. However, adoption is not a passive reaction to an innovation's momentum, instead it requires adjustments of current practices and uncertainty [23]. This change in laws, practices, or actors signifies a change in the rules of the regime **[M6]** which means that the other rules of the regime are altered by way of linkages [24]. For example, a new innovative tool of communicating after a disaster could require a new position in emergency management centers, new training for emergency responders to use the communication tool, and funding shifts from other disaster functions. Thus, the regime, already undergoing a process of stabilization through the disaster response and recovery process, will eventually stabilize in the form of a new regime **[V6]**. This new regime is the previous regime along with the incorporated changes from the adopting of the innovation. Thus, for example, the associated changes from the adoption of the innovative communication system becomes 'the way we do things now.' The new regime helps to determine the new level of vulnerability **[M8]** as some of the innovation-related changes in the rules of the regime become ingrained as norms beyond the immediate community. It does this by the innovation's associated changes becoming incorporated more broadly as it spreads leading to positive outcomes for vulnerability. Thus, using our example of the communication innovation again, if the communication innovation spread and became a way for people to connect more and increase their social capital. This increase in social capital would create a new level of vulnerability. This new level of vulnerability is the post-transition vulnerability **[Y]**. The post-transition level of vulnerability will affect the future chances of disasters and thus another disaster transition in combination with any further changes in the regime and landscape that happens prior to that next disaster. The post-transition vulnerability, however, it is not the vulnerability of the community immediately following the disaster event. A community recently affected by a disaster is likely very vulnerable should another hazard hit. Instead, it is the vulnerability of the community post-transition or after the community has gone through the causal mechanisms described or in a sense has recovered.

This cycle of transitions will continue. Greatly decreasing the level of vulnerability would reduce the likelihood of a future disasters and disaster-related transition. Consequently, the process through which the affected community experienced the prior disaster-related transitions influences the causes and experiences in the next disaster-related transition **[M9]**. Thus, for example, if the disaster-related transition decreased vulnerably to disasters through increased social capital, as social capital is one of the determinates of vulnerability, this increase in social capital would reduce vulnerability to the next disaster.

3. Methods

3.1. Process-tracing

We chose process-tracing as the method to test whether the multi-level perspective is an insightful approach for looking at disaster-related transitions. Process-tracing considers the steps of causation between the cause (or x) and the ultimate effect (or y) under study (for further information on process-tracing see Beach and Pedersen [5]. It "analyzes trajectories of change and causation" [10] which makes it an appropriate method for analyzing transitions. Grin et al. [27] have put forward process-tracing as one of several methods of examining the processes of a transition.

Process-tracing allows us to closely examine the processes by which our independent variables (or x's) cause the steps which make up a transition which ultimately cause our outcome (or y). Since we have explored what steps would need to occur in a disaster-related transition according to the available literature on the multi-level perspective and disasters (Fig. 1), we are able to explicitly lay out the steps to make a process-tracing test (Fig. 2). However, our transition is a cyclical process, thus, not only do we have the steps laid out from x through y, but we also have a mechanism (M9) which links the effect of the previous transition to the cause of the next transition. When considering our conceptualization (Fig. 1), we located eighteen steps that a disaster-related transition would go through for process-tracing test (Fig. 2). These steps consist of two causes (or x), six intervening variables (v – the concrete entities which make up the steps of the

[11] We define unmet needs for the purposes of this article to be those things which are needed by those who experienced the disaster and as a result of the disaster, but not being provided for by a regime actor, both in terms of survival, as well as those things that are needed for recovery. These needs could take place over both the short and the long term. Examples of unmet needs could include food and shelter, as well as financial and mental health needs.

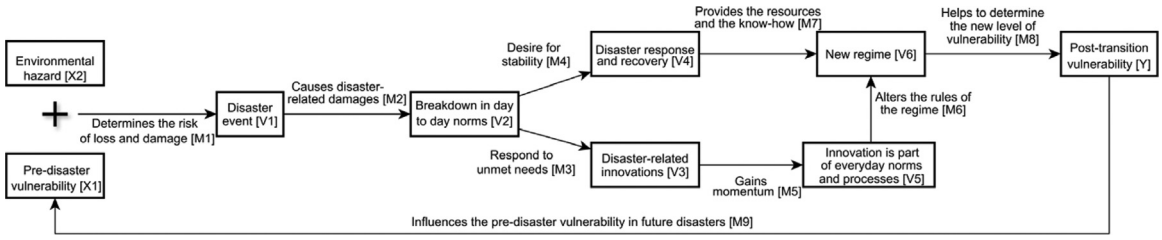

Fig. 2. The process-tracing test used here to examine disaster-related transitions. In the figure, mechanisms are represented inside of the boxes whereas intervening variables are located next to the lines.

process [5]), ten mechanisms (m – the actions that transmit the causal force [5]), and one outcome (or y). In Figs. 1 and 2, variables are presented in boxes and begin with nouns, whereas mechanisms are without boxes, but next to lines representing their role as moving the causation forward and begin with verbs.

Beach and Pedersen argue that process-tracing should "be presented as a stepwise test of each part of a causal mechanism" [5] which we have done in Fig. 2. Using this we will test "whether evidence shows that each part of a hypothesized causal mechanism is present in a given case" [5]. We will use this to better understand the chain of causation we expect to see in the case studies if there was a disaster-related transition. To prove that each of our cases comprises of a disaster-related transition, each of the theoretical steps, which includes both the mechanisms and

Table 1
Examples of what would constitute as an empirical evidence for each theoretical level.

Theoretical step	Level in multi-level perspective	X, Y, Intervening variable (V) or mechanism (M)	What constitutes empirical evidence
Pre-disaster vulnerability	Landscape	X1	Factors or proxy variables which would indicate vulnerability. For example, education levels in the impacted community.
Environmental hazard	Landscape	X2	Storm, tornado, or other physical trigger necessary for the disaster event to occur
Determines the risk of loss and damage	Landscape	M1	How a vulnerability factor (or factors) contributed to the scale and/or destruction of the disaster event and how the environmental hazard provided the opportunity to exacerbate existing vulnerabilities.
Disaster event	Landscape/regime	V1	Evidence that the event was beyond the control of the immediate community or evidence of losses that would imply the community was unable to cope
Causes disaster related damages	Landscape/regime	M2	How the disaster event caused disruption through damage, etc.
Breakdown in the day-to-day norms	Regime	V2	Factors that suggestion that the community was unable to go about its normal activities
Respond to unmet needs	Niche	M3	Citizens and small groups attempt to use social capital and other means to respond to their and their neighbor's unmet needs
Disaster-related innovations	Niche	V3	Evidence of new innovations such as new groups forming, new partnerships, or groups pursuing activities that are not within the scope or their normal activities
Desire for stability	Regime	M4	Proof through documents or statements that the government or other actors desired a return to normal activities
Disaster response and recovery	Regime	V4	Evidence of a response to the disruption through disaster response activities such as providing shelter or food.
Gains momentum	Niche	M5	Evidence that the niche innovation gained momentum
Innovation is part of the everyday norms and practices	Regime	V5	Evidence that the innovation or innovative activity became part of the everyday practices in the affected community
Alters the rules of the regime	Regime	M6	How the inclusion of the innovation in the regime created changes in the other rules and practices of the regime
Provides the resources and the know-how	Regime	M7	Through expert direction and resources, the community is able to begin to return to normal
New regime (regime stabilizes in the form of a new regime)	Regime	V6	The response and recovery phase of the disaster concludes and the affected community returns to normal pre-disaster activities albeit with some changes to the rules of the regime
Helps to determine the new level of vulnerability	Regime/landscape	M8	Evidence that the new rules of the regime altered one or more factors which contribute to vulnerability
Post-transition vulnerability	Landscape	Y	Evidence of the change in vulnerability from the pre-disaster state
Influences the pre-disaster vulnerability in future disasters	Landscape	M9	Evidence that a feature of the transition reduced vulnerability in succeeding disasters

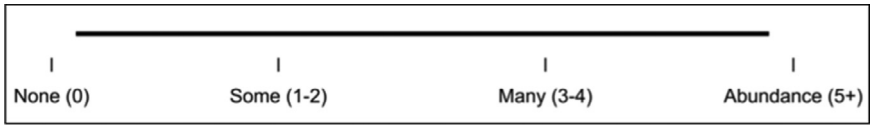

Fig. 3. Scale used to describe the number of citations found for each theoretical step. The numbers in parenthesizes represent the number of sources, which were located in the course of the research for this article, that contain empirical evidence of the related theoretical step.

intervening variables in Fig. 2, must be located.

However, because the steps at the theoretical level are often not directly observable themselves, we must look for empirical evidence (or proxy variables) that prove that the theoretical step occurred [5]. Empirical evidence must be located for each of the theoretical steps in each case study. To be clear, we outlined our expectations for what could be considered empirical evidence for each theoretical step in Table 1. Each piece of empirical evidence acts as a 'smoking gun test' in that it is sufficient but not necessary to confirm the presence of the theoretical step [45].

3.2. Evidence scale

We use a scale (Fig. 3) to clearly and uniformly convey the amount of empirical evidence located for each theoretical step. The scale allows us to go beyond a mere "yes" or "no" answer to whether evidence was located and for the clear understanding of how much was located and, in a way, how certain we can be that the theoretical step took place. This scale is used in Tables 2 and 3 when explaining the empirical evidence and the term on the scale used is in bold in these tables.

3.3. Data

Thus, for each case we will search for empirical evidence which proves that a given step is present. We will gather the empirical evidence from four categories of text:

1. Reports and press releases from government agencies.
2. Reports from aid organizations involved in the disaster, such as nonprofits.
3. Mass media reports, namely newspaper articles and online news sources.
4. Scholarly articles on the disaster cases and the aftermath.

This empirical evidence drawn from the sources listed above will be constructed into a narrative of the transition in the results section.

3.4. Case selection

We chose two cases because multiple cases show how the conceptualization plays out in different scenarios, and to ensure that the conceptualized steps are generalizable. However, we chose to limit the cases to two because the limit allows for a description of the empirical evidence for each theoretical step per case which is important for the analysis in process-tracing [10].

The two historical cases were chosen based on four criteria. (1) The event must be substantial enough to meet the definition of a disaster which we have borrowed from the United Nations which defines a disaster as "[a] serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources" [78]. This definition therefore excludes small scale everyday emergencies such as a house fire, as well as purely environmental events that do not affect human settlements. (2) The disaster should be by appearance a 'natural' disaster as opposed to manmade. This is because we are attempting to understand transitions in the context of climate change and associated increases in environmental hazards. (3) The disaster must be sudden-onset (no more than a few days warning). We chose sudden-onset because the shock of a sudden onset disaster can accelerate a transition. (4) The cases must take place in 2005 or after. This is because we are trying to understand disaster-related transitions in the context of the new institutional environment created after the development of build back better in 2004 and the Hyogo Framework for Action in 2005.

We chose catastrophic disasters over the more typical disasters, not because we believe that non-catastrophic disasters do not cause transitions, but because of the amount of information available as a result of mass interest in catastrophic disasters make it easier to account for the detailed information need for process-tracing. Moreover, catastrophic disasters represent the most likely scenario for disaster-related transitions because of the magnitude of disruption caused and the breath of the unmet needs created, which, according to our conceptualization, would lead to an increased likelihood of niche innovation and adoption.

Thus, after identifying the catastrophes that occurred after 2005 (See EM-DAT for an extensive list of disasters Guha-Sapir et al. [28]) we chose the transitions associated with Cyclone Nargis in 2008 and Hurricane Katrina in 2005 as our cases because these events occurred long enough ago to say the transition was completed. We applied the process-tracing test outlined in the methods section to determine if the multi-level perspective is a valid way of considering post-disaster transitions. The timeframe that constitutes the case is immediately prior to the disaster until the transition has finished.

4. Results

Both of our cases show that disaster-related transitions can be described using our conceptualization. For each case, a narrative of the transition using the conceptualization described earlier is discussed accompanied by a table located at the end of each narration (Table 2 for Cyclone Nargis and Table 3 for Hurricane Katrina) to further clarify which empirical evidence was located. Brackets, or '[' and ']', will follow the narrated empirical evidence noting the letter and number assigned to the corresponding theoretical step in Figs. 1 and 2 along with Table 1. We will not be attempting to provide a full narrative of the disaster response and recovery, thus events and actions may be excluded that do not fall within the theoretical steps of the process-tracing test. Moreover, we will not attempt to comprehensively cover the available evidence for each step. Furthermore, an event as disruptive as a catastrophic disaster may even spark several transitions and here we will only attempt to describe one transition associated with disaster risk reduction per disaster event.

4.1. Irrawaddy Delta's transition to decreased vulnerability (Cyclone Nargis 2008)

Our first case to be examined is Cyclone Nargis which hit the Irrawaddy Delta in Myanmar on the 2nd and 3rd of May 2008 [3]. It is a transition in that the post-transition vulnerability is lower than the pre-disaster vulnerability, despite the barriers that had to be overcome. It is an example of how institutionalized and

Table 2
Steps from our conceptualization and empirical evidence of each step from Cyclone Nargis. The words in bold under "Empirical Evidence? " represent the number of citations located with empirical evidence of the theoretical step using the scale from Fig. 3.

Theoretical step	Empirical evidence?
Pre-disaster vulnerability [X1]	**Many**. There were a number of factors that would indicate a high level of vulnerability: – High levels of poverty and poor health [65] – The Delta lies at sea level and is densely populated [67] – Internationally isolated military government [4] – Civil society was largely nonexistent as a result of civil war and divisions among ethnic groups [18]
Environmental hazard [X2]	**Many.** Cyclone Nargis – Winds of 190 [75] to 240 [73] km/h – Storm surge of around 40 km inland [67]
Determines the risk of loss and damage [M1]	**Some**. Because of their restricted access to the country, international organizations lacked staff serge capacity reducing their ability to respond to disasters [57] and thus only a few international organizations were able to respond in the early days of the disaster [77].
Disaster event [V1]	**Abundance.** There is evidence of losses which suggest that the community was unable to cope: – Cyclone Nargis affected between 1.5 [75] to 2.4 million people [65] – Killed an estimated 130,000 to 140,000 people [3,18,65,76]
Causes disaster related damages [M2]	**Abundance**. Damages included: – Infrastructure [73,18,82] – The fishing fleet [73,76] – Agricultural land [76,82] – Livestock [73,18] – Homes [67]
Breakdown in the day-to-day norms [V2]	**Abundance**. There is evidence that the community would not have been able to function as usual: – Food shortages [73,54] – A lack of clean water [73,54] – A loss of health services and education [73] – Loss of livelihoods and associated income [18,76] – One million people homeless [75] – Insufficient food and water remained more than a year after the cyclone hit [65] – Difficulties in obtaining credit remained for at least two years after the cyclone [70]
Respond to unmet needs [M3]	**Some**. There is evidence that there was a response to unmet needs: – Villagers worked together to overcome their immediate post-disaster needs [73] – The private sectors and individuals initially provided the majority of the food aid [73]
Disaster-related innovations [V3]	**Some**. For example, because local organizations were faster at delivering aid, and the Local Resource Centre (LRC) was established to link local organizations with international aid and expertise [18] in order to support local groups and communities [42]
Desire for stability [M4]	**Some**. There is evidence that regime desired stability: – The Tripartite Core Group (TCG) discusses its desire to build back better and enact disaster risk reduction in its Post-Nargis Recovery and Preparedness Plan [73] – The government of Myanmar's plan in "Programme for Reconstruction of Cyclone Nargis Affected Areas and Implementation Plans for Preparedness and Protection from Future Natural Disaster" published in 2008, explicitly mentions build back better [73]
Disaster response and recovery [V4]	**Abundance**. There is evidence of a disaster response: – The government focused largely on rebuilding infrastructure [69]. – Within a month of the disaster eighty percent of villages had received some form of aid [74]. – International Federation of the Red Cross and Red Crescent Societies (IFRC) responded by providing new homes, schools, health centers, and other community buildings (2011) – Doctors Without Borders/Médecins Sans Frontières (MSF) provided medical supplies and treatment, mental health services, and created a training programme for local councilors to do mental health interventions (2009). – Save the Children spent 50 million USD heling 720,000 people [71].
Gains momentum [M5]	**Some**. Contact between local organizations in Myanmar and international organizations began to flourish and allowed for new networks to form between local and international actors [18]
Innovation is part of the everyday norms and practices[V5]	**Some**. Some partnerships between international organizations and local groups began to expand beyond the initial disaster response activities to address other civil society and vulnerability issues [55]
Alters the rules of the regime [M6]	**Some**. There were changes as a result of initiatives: – ASEAN, the UN, and the TCG are credited with being essential to bringing about changes in government policies allowing international organizations to enter Myanmar [77]. – Shared infrastructure projects led to an increase in inter-village social capital [69]

Table 2 (*continued*)

Theoretical step	Empirical evidence?
Provides the resources and the know-how [M7]	**Some**. Regime actors have been credited with providing resources and other assistance [50].
New regime (regime stabilizes in the form of a new regime) [V6]	**Some**. Five years after the disaster, things began to stabilize and return to normal [55].
Helps to determine the new level of vulnerability [M8]	**Many**. The increased social capital [69] and other positive features of the new regime, such government reforms [4] and a greater connection to international organizations have allowed for the changes seen in the post-transition vulnerability [18]
Post-transition vulnerability [Y]	**Some**. Vulnerability has improved in a number of factors: – Increased social capital [69] – Reforms in the government [4] – Increased access to international organizations [18]
Influences the pre-disaster vulnerability in future disasters [M9]	**Some**. There is evidence that features of this transition impacted the pre-disaster vulnerability in subsequent disasters: – Local networks that were created after Cyclone Nargis have responded to more recent disasters [18]

embedded the principles of disaster risk reduction had become in the landscape that governments who do not, or cannot, enact disaster risk reduction policies may be threatened with a violation of their sovereignty.

A number of factors point to a high level of vulnerability in the delta before Nargis hit. For example, the vulnerability of the people of the Irrawaddy Delta was magnified by poverty [65] and Myanmar had an internationally isolated military government [4] [**X1**]. These vulnerabilities dictated the scale and destruction of the disaster event. For example, as a result of the isolation of the government, international organizations had restricted access to the country. Because of this restricted access, many international organizations lacked staff serge capacity reducing their ability to respond to disasters in the area [57] and this limited access likely prolonged the suffering of residents in some communities [77] [**M1**].

The environmental hazard, Cyclone Nargis, had winds of 190 [75] to 240 [73] kilometers per hour and storm surge that reached 25 miles (around 40 km) inland [67] [**X2].** Cyclone Nargis affected between 1.5 [75] to 2.4 million people [65], and killed an estimated 130,000 to 140,000 people [3,65,76] which is beyond what the affected communities would be able to handle without outside assistance thereby meeting the definition of a disaster [**V1**].

The cyclone caused a significant amount of damage including to infrastructure [73,82], the region's fishing fleet [73,76], agriculture [76,82,73], as well as destroying ninety-five percent of homes within seven townships [67] [**M3**]. This led to a breakdown in the day-to-day norms with food shortages [73,54], as well as a loss of livelihoods [76] and it also left around one million people homeless [75] [**V2**].

While most of the international aid and the aid workers were unable to reach the survivors in the immediate aftermath of the storm, local community-based organizations were created in response to the unmet needs of the survivors [65] and villagers worked together to overcome their immediate post-disaster needs through "collective action and problem solving" [73] **[M3].** In order to support these local groups and communities [42], the Local Resource Centre (LRC) was established to link local organizations with international aid and expertise [18] **[V3].**

Unfortunately, the government of Myanmar was initially unable to coordinate disaster relief [38]. However, it did express its desire for a return to stability and several government reports described its plans for disaster risk reduction activities [66]. Moreover, the government's "Programme for Reconstruction of Cyclone Nargis Affected Areas and Implementation Plans for Preparedness and Protection from Future Natural Disaster" published in 2008, explicitly mentions build back better [73]. However, the government's fears of international intervention in the country's internal affairs and fear of armed invasion [62] made it hesitant to allow international organizations access within its borders and it initially restricted international aid and aid workers [65,3,54].

However, while the government, a regime actor, resisted the landscape pressure, the other regime actors enforced it. Starting with Bernard Koucher, the French foreign minister at the time, there were calls for invoking the "responsibility to protect" which called for the United Nations to use force to provide aid to the cyclone victims [54,75]. This was the result of the institutional environment which created an expectation that legitimate governments provided disaster assistance to their affected citizens or accept the assistance of others. The mounting pressure eventually resulted in the government of Myanmar allowing international aid and aid workers into the country [65], although they still required restrictive conditions on humanitarian assistance [62]. The Tripartite Core Group (TCG), a group designed to coordinate the response and recovery consisting of the Government of Myanmar, the Association of Southeast Asian Nations (ASEAN), and the United Nations (UN), also discussed the desire to build back better and enact disaster risk reduction in its Post-Nargis Recovery and Preparedness Plan [73]. Thus, overall the regime actors desired stability and conformity within international norms, however, barriers such as a fear of loss of control, made it difficult for the government to act on that desire [**M4**].

Acting on their desire for stability, the regime actors undertook a variety of disaster response and recovery measures. The government focused largely on rebuilding infrastructure [69]; while other regime actors, such as the International Federation of the Red Cross and Red Crescent Societies (IFRC), Doctors Without Borders/Médecins Sans Frontières (MSF), and Save the Children focused on their areas of expertise [32,48,71]. Meanwhile, the TCG saw its role as providing support for the independent programs as well as "coordination and coherence" (2008). Within a month of the disaster, eighty percent of villages had received some form of aid [73]. The disaster response shifted to disaster recovery around one year after the disaster [69]. As part of the response, the TCG

planned for the involvement of both formal and informal community groups in all stages of the recovery in its Post-Nargis Recovery and Preparedness Plan [73] **[V4]**.

The partnerships between international organizations and local organizations began to flourish and allowed for new networks to form between local and international actors [18] **[M5]**. Some partnerships between international organizations and local groups began to expand beyond the initial disaster response activities to address vulnerability issues beyond those immediately related to the ongoing disaster. For example, the exposure to international aid organizations from abroad led to campaigns such as the one conducted by Karuna Myanmar Social Services to increase awareness of the importance of education which ultimately increased the number of children attending school [55] **[V5].** As such innovations became further part of the regime, they facilitated further changes in the regime's norms. In the Inter-Agency Real Time Evaluation of the Response to Cyclone Nargis, ASEAN, the UN, and the TCG are credited with being essential to bringing about changes in government policies that allowed many international aid organizations to enter Myanmar and strengthened the relationship between these international actors and local organizations [77]. This, for example, led to shared infrastructure projects which led to an increase in inter-village social capital [69] **[M6].**

While the local initiatives responded to the disaster, they needed the coordination, resources, and knowledge provided by the regime to increase their effectiveness. For example, the Metta Development Foundation, a non-government organization originating in Myanmar [51] credits the international organizations that operated following Cyclone Nargis with "sharing resources… disaster and emergency-related assistance… [and] organizational development training" with local organizations and partners [50] **[M7].**

Five years after the disaster, things began to stabilize and return to normal [55]. However, the new stabilized regime incorporated both the initiatives which had gained enough momentum as well as the associated rule changes **[V6]**. With this, the increased social capital [69] and other positive features of the new regime, such government reforms [4] and a greater connection to international organizations [18], have the potential not only to benefit the people of the Irrawaddy delta, but also of the country as a whole **[M8]**.

Thus, the post-transition level of vulnerability in the delta was lower than the pre-disaster level of vulnerability. Increased social capital [69], reforms in the government [4], as well as increased access to international organizations [18] reduced vulnerability **[Y]**. Whereas before the disaster it was assumed that a history of division among identity groups had caused a breakdown in civil society, the increased social capital after Cyclone Nargis led to local networks that have responded to more recent disaster events [18] **[M9].**

4.2. New Orleans' obstructed transition (Hurricane Katrina 2005)

Hurricane Katrina is an example of niche innovations lacking sufficient support from regime actors and, as a result, failing to become positive casual forces in the transition. The result for New Orleans was that many of the niches that formed, formed in response not only to the many unmet needs, but also formed in response to the mistrust that developed towards the government. This mistrust stemmed from the exclusion of community groups from decision making in the disaster response and recovery as well as the perceived inequality in rebuilding. Thus, the niches sought to rebuild what was before and the government, a regime actor, attempted to impose disaster risk reduction measures, leading to a mismatched recovery effort that prevented New Orleans from improving its vulnerability. In this way, "Katrina demonstrated that well-meaning intentions by individuals, agencies, and nonprofits to rise to the occasion are not sufficient" [49]. Instead a coordinated effort and partnership between regime actors and niche innovations is needed to bring about a transition to decreased vulnerability.

Several factors contributed to the vulnerability of New Orleans. New Orleans had high levels of poverty combined with "an unsustainable development pattern, and a weak economy" [41]. Articles and reports both before [21] and after [12,37,11,20,35] Hurricane Katrina have pointed to the high level geographical vulnerability of the city **[X1]**. One vulnerability factor in particular that would play a large role in shaping the narrative of the disaster was poverty. It was the inability of a large number of individuals and families to evacuate caused by poverty that would result in the human suffering that followed Hurricane Katrina [61] **[M1].** The environmental hazard in this disaster, Hurricane Katrina, was a category 3 hurricane, out of a scale of 1–5, with winds of 125 miles per hour [34] **[X2]**.

There is evidence that the event was beyond what a community would be able to handle as a state of emergency was declared both by the mayor of New Orleans, as well as the governor of the state of Louisiana, in which New Orleans resides, before the hurricane hit [9,64]. This act prepared the way for resources from outside the community to be used in the response thereby meeting the definition of a disaster **[V1]**. The disaster caused significant damage including the flooding of eighty percent of New Orleans [34,12,2] and killed between 1570 [35] to over 1800 people [41,2] **[M2]**. This damage caused a breakdown in everyday norms including the around 300,000 homes made uninhabitable by the storm, 1.7 million people were left without electricity [11], and "[t]ens of thousands of jobs were lost" [34]. The destruction of the disaster led to "almost total disruption of community functions" [56] and many "communities had been 'obliterated'" (ABC News, 2005 quoting President George W. Bush [1]) **[V2]**.

Prosocial activities made up the majority of the initial disaster response including many new emergent activities [59]. These activities were in response to the unmet needs due to the failure of the local, state, and federal government to meet the needs to the storm victims and fulfill the "obligation to provide for the common welfare" [61]. For example, the government's disaster plans failed to account for the people left-behind in the city during the storm, and thus only provided two shelters in the city, one of which was lacking supplies of food or water [11]. In response, informal groups weathered out the storm and its aftermath together [59,29]. Moreover, some helped their neighbors through search and rescues [11,46,59,29] after it became clear that the government's disaster response was overwhelmed **[M3].**

The disaster also spawned innovations. For example, an emergent group formed Katrina Wiki to provide a central place for information to disaster victims [46], and new groups formed from pre-existing movements such as the Common Ground Collective, The People's Hurricane Relief Fund, and a new campaign was launched by the Association for Community Organizing and Reform Now [44]. The poor handling of the response and recovery of New Orleans has led many locals, who were distrustful to begin with, to become increasingly mistrustful of the government [40]. The lack of inclusion of the community in the response [44] as well as the history of civil activism within New Orleans [40] resulted in many innovations in the form of advocacy groups. These advocacy groups rejected the Stanford Act, the main disaster policy of the United States, and instead focused on the idea of the human rights response to disasters as well as on service provision and resistance activities [44] **[V3]**.

Meanwhile, the regime actors desired a return to stability as was made clear through various speeches and reports [41]. Then President Bush [68] as well as other regime actors such as the U.S.

Table 3
Steps from our conceptualization and empirical evidence found for each step from Hurricane Katrina. The words in bold under "Empirical Evidence? " represent the number of citations located with empirical evidence of the theoretical step using the scale from Fig. 3.

Theoretical step	Empirical evidence?
Pre-disaster vulnerability [X1]	**Many**. There are a number of factors which would indicate a high level of vulnerability in New Orleans including: – high levels of poverty [41] – "an unsustainable development pattern" [41] – a poor economy [41] – Much of New Orleans was below sea level [15] – New Orleans was sinking [21]
Environmental hazard [X2]	**Some**. The environmental hazard, Hurricane Katrina, was a category 3 hurricane out of a scale of 1–5 with winds of 125 miles per hour [34]
Determines the risk of loss and damage [M1]	**Some**. For example, the inability of a large number of individuals and families to evacuate caused by poverty that would result in the human suffering that followed Hurricane Katrina [61]. Moreover, New Orleans had reduced its vulnerability to smaller storms, thus it was only the larger storms that provided the opportunity for disaster [35]
Disaster event [V1]	**Some**. There is evidence that the event was beyond what a community would be able to handle as a state of emergency was declared both by the mayor of New Orleans, as well as the governor of the state of Louisiana, in which New Orleans' resides, before the hurricane hit [9,64]. This act prepared the way for resources from outside the community to be used in the response thereby meeting the definition of a disaster
Causes disaster related damages[M2]	**Abundance**. The disaster caused significant damages including: – The flooding of eighty percent of New Orleans [34,12,2] with flood waters around 15–20 feet [34]. – It damaged 90,000 square miles of land [11]
Breakdown in the day-to-day norms [V2]	**Abundance**. A number of factors suggest that the community was unable to go about its day-to-day norms: – The disaster destroyed much of the communication infrastructure within the affected area [13,53] – The weapons and ammunition of the police force was lost to flooding [11] – Around 300,000 homes were made uninhabitable by the storm – ~1.7 Million people were left without electricity [11] – "[t]ens of thousands of jobs were lost" [34] – Highways around New Orleans were damaged or destroyed [34] – Many local mental health and welfare organizations were unable to operate [56]
Respond to unmet needs [M3]	**Abundance**. there is evidence of a response to unmet needs including: – Many individuals used their social networks to plan their evacuation from New Orleans in groups [29]. – Emergent informal groups weathered out the storm and its aftermath together [59,29]. – Some individuals helped their neighbors through search and rescues and other activities [11,46,59,29] after it became clear that the disaster response was overwhelmed. – Some individuals raided pharmacies for medication and set up ad hoc clinics to treat those in need of medical attention [61] – Some individuals provided first aid [46]
Disaster-related innovations [V3]	**Many**. there is evidence of innovations such as: – An emergent group formed Katrina Wiki to provide a central place for information to disaster victims [46]. – new groups formed from pre-existing movements such as Common Ground Collective, The People's Hurricane Relief Fund, and a new campaign was launched by the Association for Community Organizing and Reform Now [44]. – Many private companies and NGOs that do not normally operate in disaster relief provided assistance where they could, for example, Walmart and the Baptist Encampment [58] However, the lack of inclusion of the community in the response [44] as well as the history of civil activism within New Orleans [40] resulted in innovations in the form of advocacy groups focusing on service provision and resistance activities [44]
Desire for stability [M4]	**Many**. There is evidence that regime actors desired a return to stability as was made clear through various speeches and reports [41]. Moreover, then President Bush [9] as well as other regime actors such as the U.S. House of Representatives [61], and the American Red Cross [2] indicated that they not only wanted to rebuild New Orleans back to what it was, but instead wanted to rebuild an improved New Orleans. They wanted to build it back better.
Disaster response and recovery [V4]	**Many**. There is evidence of a disaster response and recovery be the regime: – The federal government put into place a bill of 10.5 billion U. S. dollars to provide disaster aid to the affected region several days following the hurricane [19] and had spent a total of 88 billion U. S. dollars on the response and recovery efforts by March 2006 [11]. – The deployment of 50,000 National Guard Troops [11] – The American Red Cross opened 1400 emergency shelters in 31 states, provided 68 million hot meals and snacks, and more than 1.4 million families received emergency assistance in purchasing needed items [2]
Gains momentum [M5]	**None**. The lack of inclusion of niches in the disaster response injured their ability to gain momentum.
Innovation is part of the everyday norms and practices [V5]	**None**.

Table 3 (*continued*)

Theoretical step	Empirical evidence?
Alters the rules of the regime [M6]	**None**.
Provides the resources and the know-how [M7]	**Some**. Evidence suggests that resources were provided including: – FEMA trailers, housing assistance, and loans [61]
New regime (regime stabilizes in the form of a new regime) [V6]	**None**.
Helps to determine the new level of vulnerability [M8]	**None**.
Post-transition vulnerability [Y]	**None**. As the transition was not completed, there is no post-transition vulnerability.
Influences the pre-disaster vulnerability in future disasters [M9]	**None**.

House of Representatives [61], and the American Red Cross [2] indicated that they not only wanted to rebuild New Orleans back to what it was, but instead wanted to rebuild an improved New Orleans. They wanted to build it back better **[M4].** Because of both the scale of the disaster event and the desire of the regime to return to stability, the regime's disaster response and recovery after Hurricane Katrina was massive. The federal government put into place a bill of 10.5 billion U.S. dollars to provide disaster aid to the affected region several days following the hurricane [19] and spent a total of 88 billion U.S. dollars on the response and recovery efforts by March 2006 [11], seven months after the hurricane struck **[V4]**.

The government response was unable to make use of the response activities provided by citizens [61]. Instead of providing additional resources and personnel to enhance an on-going relief effort; many non-governmental organizations found themselves either on their own or turned away [12,17] and "failures at all levels of government … significantly undermined and detracted from the heroic efforts of first responders, private individuals and organizations, faith-based groups, and others" [61]. Furthermore, the government's failure to plan for and coordinate the efforts of non-profits made it more difficult for them to respond to Hurricane Katrina in the first place [17]. This lack of inclusion of niche innovations in the disaster response injured their ability to gain momentum **[M5]**. Moreover, once the disaster response ended and the recovery began, there was no official role for community groups in the rebuilding of New Orleans [12] and thus, the innovative activities failed to be incorporated into the day-to-day norms **[V5].**

Because innovations neither gained momentum nor became part of the everyday norms, they also did not alter the rules of the regime. Instead, many innovations took the form of advocacy groups with the main goal of challenging the rebuilding efforts directed by the government [44] which had hoped to rebuild a less vulnerable New Orleans [68,61] or build back better. Thus these innovations actively worked against activities that would lead to the regime rule changes that would reduce vulnerability **[M6].**

Nonetheless, the regime provided many resources that helped New Orleans recover and thus stabilize, such as FEMA trailers, housing assistance, and loans [61] **[M7].** However instead of a new regime forming after the incorporation of innovations and associated regime rule changes, community pressure prevented city planners from using their master plan for rebuilding the city [16] and reducing vulnerability. There was a rush to rebuild what had been there before which had happened after so many disasters prior to Katrina [35] and New Orleans thus restabilized in the form of the previous regime instead of a new regime **[V6].** Because the regime did not change, it was unable to positively influence the factors of vulnerability **[M8].**

As the transition was not completed, it is not possible to have a post-transition level of vulnerability **[Y]** and have that post-transition level of vulnerably influence the pre-disaster vulnerability in future disasters **[M9]**. In fact, it has been found that the vulnerability of New Orleans to the next large environmental hazard has increased following Hurricane Katrina as a result of the continued development pattern and the raising of the levees only high enough to prevent an event similar to Hurricane Katrina [35].

A lack of evidence of the transition continuing does not mean, however, that none of the things that would qualify as evidence exists and proving the complete absence of this evidence is difficult. However, a lack of evidence located does cast doubt on the existence of such evidence [45]. Moreover, no evidence was located for several successive steps making it even more unlikely that such evidence and the steps exist in the case of Hurricane Katrina.

4.3. Barriers to transitions

In both cases presented, barriers that hindered or had the potential to hinder a post-disaster transition were present. The two

Table 4
How the barriers manifested in each case study.

Barriers	Cyclone Nargis	Hurricane Katrina
Lack of capacity	Government officials had a lack of capacity to respond to the disaster [18]	Funding cuts were experienced by government agencies prior to the disaster [61]
Desire for control	Desire for control led to the government resisting international involvement and ultimately insisting on partnerships as a condition for allowing international organizations to respond to the disaster [54,65].	The desire for control by the government over the response and recovery led to the exclusion of local organizations and movements [61,81,17,12,44]

barriers found in both case studies are both shown in table 4 as well as described further below.

After Cyclone Nargis, local organizations lacked resources rendering it difficult for them to respond to the disaster. This could have prevented a transition as a lack of resources for niche actors would make it difficult for them to achieve momentum. However, it was this same lack of resources along with the institutionalization of build back better under the Hyogo Framework for Action which allowed the international community to begin a discussion on the "responsibility to protect." It was the second would-be barrier, the government's desire to maintain control, that led to the partnership both between international and local organizations, as well as the creation of the Tripartite Core Group (TCG), a partnership between Government of Myanmar, the Association of Southeast Asian Nations (ASEAN), and the United Nations (UN). The partnerships between the international and local organizations gave the niches the support and resources needed to innovate and gain momentum.

In the case of Hurricane Katrina, the local, state, and federal agencies responsible for disaster response suffered from cuts and a lack of funding before the disaster hit [61] causing issues in the response and recovery. Moreover, innovations suffered from a lack of access to resources when they were excluded by the regime response. The command and control structure led to exclusion of emergent groups and innovations in the disaster response and recovery [81]. This in combination with the lack of resources injured the ability of the niches to gain momentum. This greatly injured the ability of the regime to enact disaster risk reduction measures as innovations focused on the "right to return" [12] and opposed the disaster risk reduction policies favored by the government.

5. Discussion

The results suggest the presence of a disaster-related transition that reduced vulnerability in the Irrawaddy Delta. This is based on empirical evidence for each step in the process-tracing test which was created by conceptualizing disaster-related transitions based on the disaster and transition literature. For New Orleans there is evidence that a transition began, however, there is a lack of evidence that the initiatives gained momentum **[M5]** and became part of the everyday norms and practices **[V5]**. Thus, there is a lack of evidence of a completed transition to lower vulnerability. However, based on these cases, we are able to answer the five key questions posed in the introduction.

Firstly, the multi-level perspective has been used in this article to describe two disaster-related transitions (one transition being successful in reducing vulnerability while the other likely fails). The conceptualization of the transition highlighted how such a transition could occur and merged both disaster and transition literature. Moreover, the conceptualization allowed us to examine how the transition plays out across different societal levels. The method chose to assist us with it, process-tracing, allowed for a detailed understanding of the causation within the transition and allowed us to test the validity of the conceptualization. However, though not shown in the case studies presented here, it is possible to speculate that the multi-level perspective would not be useful to examine disaster events which were not severe enough in their impacts to spark a transition. Moreover, additional case studies and empirical evidence would be needed to prove that this conceptualization was applicable and useful in a diverse range of post-disaster situations. Further studies could expand upon the dynamics of disaster-transitions to better understand, for example, why it is so difficult for innovations to be incorporated into the regime and gain regime support.

Secondly, both transitions were affected by the new institutional environment that developed after the Hyogo Framework for Action and the concept of build back better. This can be seen clearly in the case of Cyclone Nargis where it led to the international community applying pressure on Myanmar to accept aid, which helped to move the transition forward. After Hurricane Katrina, the institutionalization of the concept of build back better shows in the words and attempted actions by the government and other regime actors. However, it also shows that the institutionalization in the regime alone was not enough to overcome the barriers in that transition and that building back better necessarily must include the community and community organizations.

Thirdly, with knowledge that there are disaster-related transitions comes the question on what policies to implement to appropriately manage them. Transitions literature offers suggestions such as transition management and strategic niche management which could augment what is already known about managing disasters. For example, transition management emphasizes "learning processes and polycentric governance" [30] as well as practices such as learning-by-doing, empowering selected niches with space and support to innovate, and accepting that there is no one-size-fits-all approach [43]. If such approaches from transition studies were to be adopted by disaster managers or even other regime actors (such as large non-profits), it may provide an avenue for increased support for innovations and community organizations post-disaster. These transition management policies also address some of the barriers described below. However, further research would need to be conducted to determine to what extent transition literature can be useful for managing disasters.

Furthermore, our case studies suggest that it is important for regime actors, such as large disaster response organizations, companies, or government, to be required to work with or through local groups as part of their disaster response and recovery efforts. This could be done through policies or monetary incentives, ideally planned in advance of the disaster, however Cyclone Nargis shows that this is also possible after the disaster has hit. This forced interaction may provide the necessary resources or networks to engender disaster-related innovations, as happened after Cyclone Nargis. This interaction may also allow the innovations, which are more often located on the local level as that is where most of the unmet needs are located, to influence and thus become incorporated into the regime. Such policies would also have the added benefit of mitigating some of the regime's control over the disaster response and recovery – perhaps weakening the regime enough to allow for niche innovations to breakthrough.

Fourthly, in both cases, barriers (shown in Table 4) to the disaster-related transition manifested themselves, however their outcomes were different. Two barriers present in both cases are: a lack of capacity and the government's desire to maintain command and control over the post-disaster situation. For Katrina, these barriers likely prevented a transition. Conversely, in the case of Nargis due to a combination of the institutionalization of build back better and the government's desire to restrict external influence, measures that nurtured niche innovations were implemented.

Lastly, both transitions and disaster research can learn from each other. For example, transition literature places central importance on the growth and development of niche innovations, which in our conceptualization is disaster-related innovations such as community organizations, the importance of which can be seen in the transitions associated with both Katrina and Nargis. Although innovations are increasingly recognized as important to response and recovery in the disaster literature, their role as a cause of change is not recognized to the degree it is in transition literature. Moreover, transition studies can also learn from the

older field of disaster studies. For example, disaster literature has categorized the types of improvisations that take place after disasters (reproductive, adaptive, and creative improvisation [80]) which are roughly equivalent to the idea of innovations. A categorization of the types of innovations, to the best of our knowledge, has not yet been done in the context of transitions and thus this categorization may prove a useful starting point. However, further research would need to be done to explore whether this typology would be appropriate.

6. Conclusion

The use of the multi-level perspective and our conceptualization allows for the recognition of which societal levels and where in the transition the barriers to disaster risk reduction occur. In ongoing disaster responses and recoveries as well as studies of past disaster events, this could be helpful to pinpoint at what step the post-disaster transition is or was, and thus what activities should be a focus for the recovery and moving the transition forward. It could also be useful in indicating when a post-disaster transition has stalled, as was the case for Hurricane Katrina, and thus signaling that action should be taken to put the transition back on course. In this article we used process-tracing and our conceptualization to test for post-disaster transitions. The first case, Cyclone Nargis, displays a post-disaster transition as we have conceptualized it. The second case, Hurricane Katrina, begins by following the conceptualization, however, this transition is not completed and there is evidence of each step until the disaster-related innovations should have gained momentum.

For further studies on disasters, recognition of the steps in the post-disaster transition may allow for the suggestion of which policies may help to overcome barriers to the port-disaster transition moving forward. For example, in both case studies presented here there were barriers to the post-disaster transition. For post-Cyclone Nargis, two barriers, a lack of available resources and government desire for control, were overcome and helped shape the transition to lower post-disaster vulnerability. However, the same barriers prevented a complete transition to lower post-disaster vulnerability after Hurricane Katrina. The elements missing from post-Hurricane Katrina New Orleans, but present after Cyclone Nargis, were the collaboration between regime and niche actors and the role of the international community in forcing the national government to give up some control. This would suggest that policies that stress cooperation and reduce command and control approaches in post-disaster settings would be helpful. Knowledge acquired through further studies of post-disaster transitions may identify new barriers and suggest other policies that may prove useful in post-disaster settings.

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