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Analyzing Community-based and Centralized Approaches
to Natural Disaster Management:

A Comparative Case Study Analysis in Southeast Asia

A Thesis in Environmental Studies and Sustainability

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Abstract

Tropical cyclones are among the worst of natural disasters that occur on a regular basis, affecting millions of people annually. Although not all regions experience the threat of intense cyclonic events, certain regions are highly susceptible to the devastating effects that are present with these storms. With the growing concern regarding climate change, vulnerable countries are forced to examine disaster management policy and analyze the potential risks associated with natural disasters and how they could impact populations in an altered climate going forward. This paper addresses the mechanisms that were in place in the disaster management efforts in Bangladesh and Myanmar and to what extent they were effective in reducing risk for vulnerable populations. A comparative case study analysis was conducted using Cyclone Sidr which struck Bangladesh in 2007 and Cyclone Nargis which impacted Myanmar in 2008, both occurring within a relatively similar time frame. The contrasting disaster management approaches of top-down and bottom-up approaches were identified and results indicate that the community based approaches appeared to be more effective in reducing risk for vulnerable populations, yet a wide variety of attributable factors were also uncovered in this study.

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1. Introduction

The effects of climate change are readily being displayed around the world. Projections centered on climatic studies indicate that such effects will likely progress and become more intense, producing major concerns and implications for humanity. Climate-induced effects such as sea-level rise and the warming of oceans more broadly are expected to intensify in the next few decades, similar to increases we have seen in previous decades (Bindoff et al., 2007). Climatic effects have the ability to not only degrade various aspects of human life but most importantly can result in massive mortality rates over time in the most severe cases. Of the numerous aspects of climate change, arguably the most dangerous with respect to human life come in the form of natural disasters. Global devastation as a direct result of natural disasters is already relatively clear, yet the impacts are even more apparent when focusing on developing countries that are often located in highly vulnerable regions and tend to lack the resources required to effectively prepare for disaster events. Further, many of these countries are already disproportionately affected by economic and social vulnerabilities, so natural disasters will likely amplify the global disparities that already exist, so action is necessary in the management of natural disaster events (Walker & Birmingham, 2011). Although natural disasters are relatively common around the world, many countries find themselves unable to successfully manage the intensity of disaster related events and the outcomes can be truly devastating. With increasing concern for countries around the world, adaptation strategies are proving their significance, however there is still uncertainty regarding the appropriate method that is required to effectively reduce risk (Azad et al.,

2019). There must be more emphasis on vulnerable regions with respect to disaster management strategies to ensure the safety of local populations as well as preventing additional economic, social, and environmental impacts attributed to climate change going forward.

Although natural disasters are fueled by complex climate interactions, anthropogenic climate change is playing a role in altering such interactions which could potentially intensify natural disasters (O'Brien et al., 2006). Yet, over time it has become clear that although societies are unable to fully mitigate potential disasters and prevent them from occurring, they can play a major role in the minimization of the effects of such disasters through adaptation (O'Brien et al., 2006). It is for this reason that disaster management is crucial as preparation for potential disasters can ultimately prevent large scale economic disruption and political catastrophes, but more importantly can save lives. Further, it is worth noting that disaster management policies vary greatly and are dependent on the country being studied and can vary somewhat with diversified political and economic systems. Although such factors can shape domestic response to natural disasters, it is important to recognize that there are disparities in the disaster management sector when comparing different countries. Examining the contrasting policy approaches to natural disasters that have been implemented over the years allows us to determine the extent at which different countries possess unique methods of preparing for and responding to natural disasters and the implications of the potential disparities. For example, some countries have adopted approaches that look to engage local communities in addressing disaster related concerns (Azad et al., 2019). Other approaches have

adopted the hierarchical approach which enables as single governing body or authority to manage and maintain disaster management strategies (Scolobig et al., 2015). In integrating these discourses and analyzing specific case studies we are able to then determine which disaster management policy approaches are effective and which methods result in failure.

The inability to address disaster related concerns could pose major consequences in a variety of a different ways. As mentioned above, there are already considerable inequities present as disaster events inherently produce an unequal distribution of potentially harmful outcomes for communities. Flood exposure and impact has been studied to the degree that scholars have established a link between climate justice and flooding from disasters (Walker & Burningham, 2011). The concerns here are related to the need for a more transparent approach to addressing natural disasters as the issue regarding the climate justice field comes down to responsibility; with disasters, it is difficult to assert who is responsible for tragedies that are deemed somewhat “natural,” further indicating a need for clarity as for a method that will effectively reduce risk for intrinsically vulnerable populations (Walker & Burningham, 2011). Additional concerns are focused on the call for equal representation in disaster management approaches. When utilized, certain communities are often left out of community-based approaches and thus there is an inequality component that exists (Sze & London, 2008). The failure to include all communities in disaster management only hinders and opportunity for growth when looking for innovation amidst a climate disaster of its own. As a result, it is

crucial that the any methods or approaches identified in the disaster management field make the conscious effort to address these issues before they are implemented.

This paper will aim to address the concerns outlined in this section in an attempt to determine a specific framework that can be implemented in disaster management operations on a larger scale. This study consists of a literature review where any pertinent information as well as findings from scholars in the field will be included, followed by a methods section that indicates the method of analysis. The succeeding section is a discussion of the analytical criteria used in this study, derived from information in the literature review section. The following sections consists of background information on the two countries being analyzed and the specific case studies of tropical cyclones for each country. The analytical criteria are then investigated in the analysis section, which is followed by the discussion and conclusion sections which make theoretical connections between disciplines. Figure 1 below summarizes the basic layout and acts as a roadmap for the paper:

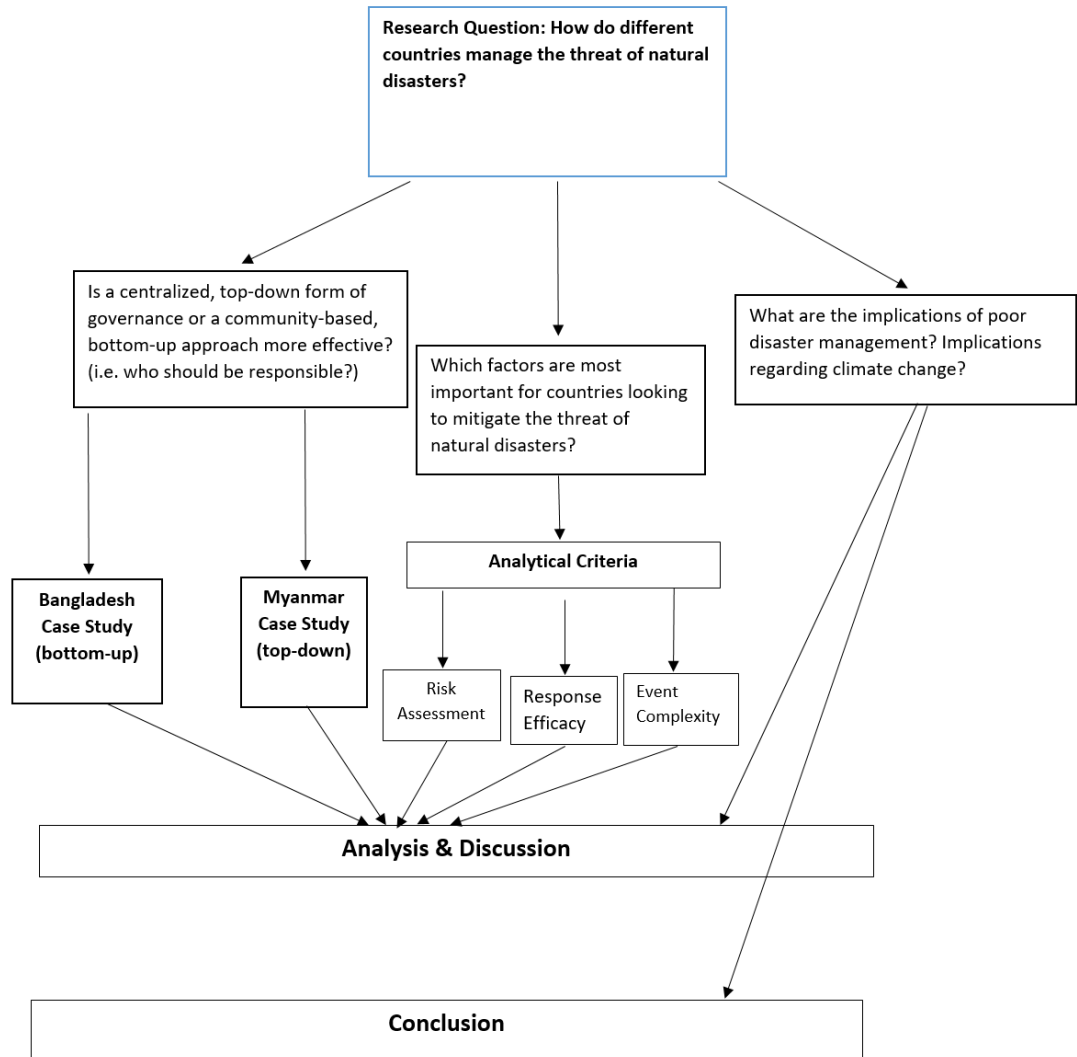


Figure 1: Roadmap and Summary of Analysis

2. Literature Review

Climate Change & Natural Disasters

Climate change is a scientific phenomenon that has received considerable attention from scholars from a variety of fields in recent years due to its potential impacts on the planet. One of the essential features of climate-induced warming globally is the complexity with making projections because not only are changes in climate intrinsically difficult to interpret for researchers but the effects of climate change vary across the globe. Yet, despite the complexity here, major findings from the Intergovernmental Panel on Climate Change (IPCC) reports over the years suggest that changes in mean global temperature, albeit just a fraction of the major climate concerns, will be accountable for the most notable climate-related risk for humanity over the course of the next few decades (IPCC, 2018). Historically, climatic shifts of roughly 0.5 degrees Celsius have caused considerable shifts in intensity and frequency severe weather events, thus using the anticipated global temperature anomaly of an increase of 2 degrees, there is very high confidence among climate scientists that human populations will be faced with more intense climate related risks as climate-induced warming continues (IPCC, 2018). The conclusions that were formed based on these findings use the assumption that environmentally harmful anthropogenic activities will continue, posing major consequences for the occurrence of dangerous climate-induced events going forward.

Natural disasters have existed throughout history and have been affecting humanity long before our awareness of the presence of climate change. Specifically,

hydro meteorological disasters such as tropical cyclones have always occurred naturally without the amplification of climatic effects; however recent data suggests that interactions between such disasters and a warming climate could be hazardous (Basher, 2008). With respect to tropical cyclones, scientists believe climate change will act as an amplifying factor that will provide more favorable conditions for the formation of disasters and could potentially affect the duration and intensity of tropical cyclones (O'Brien et al., 2006). The effects of a warming climate will significantly increase vulnerability of populations around the world, many of which are already greatly susceptible to fluctuations in their respective environments. This idea also hints at a common theme related to climate change in that the effects commonly generate inequities between nations as the impacts are often distributed disproportionately (Basher, 2008). This assertion applies to natural disasters as well; vulnerable nations, such as developing countries located in coastal areas, are generally much more susceptible to the effects of climate change as a result of geographical characteristics and thus are significantly more vulnerable to natural disasters (Hossain et al., 2008). Vulnerability is a key factor and can play a significant role in the impacts related to natural disasters, but other factors are focused more on the actual severity of disasters such as tropical cyclones.

The driving factors that shape the overall intensity of tropical cyclones are commonly shaped into three categories: wind intensity, precipitation and storm surge, identified as the forceful displacement of sea water onto land (Anthes, 2016). Heavy winds are a major effect of tropical cyclones and play a massive role in the physical devastation to communities. Of the three factors, storm surge is widely considered to be

the most dangerous of the effects of tropical cyclones, mainly due to the unpredictability present in forecasting (Anthes, 2016). Storm surge is used extensively in emergency planning efforts as a representation of the severity of ensuing tropical cyclones as it is generally perceived as the deadliest of effects for vulnerable populations (Anthes, 2016). Surge-related inundation has the ability to wipe away foundations in coastal regions, and when combined with heavy winds commonly associated with catastrophic cyclones, the impacts of cyclone events for vulnerable regions can be massive. It is also worth noting that the most intense tropical cyclones can decimate even wealthy regions as has occurred in coastal regions in the U.S. and other developed nations, so the potential impact for developing countries that are significantly more vulnerable to these disasters should be considered.

The confidence among scientists regarding the intensity of tropical cyclones in an altered climate has grown tremendously in the last decade or so. Studies have demonstrated an identifiable link between the intensity of tropical cyclones and climate change (Knutson et al., 2020). Global climate change presents serious implications for the risk of coastal communities which commonly experience tropical cyclones. The two effects that have been studied extensively in relation to climatology are sea level rise and the overall warming of ocean sea surface temperatures (Alam & Dominey-Howes, 2015). Sea-level rise is frequently considered when analyzing the potential impacts of climate change, not just with respect to tropical cyclones but many other scenarios as well. Numerous regions around the world are experiencing the effects of rising sea levels in relation to climate related events as low-lying areas are becoming uninhabitable due to

inundation, especially in developing countries (Walker & Burningham, 2011). Higher sea levels allow for a larger storm surge because there is a larger supply of water for cyclonic systems to gather and displace onto coastal regions (Alam & Dominey-Howes, 2015). As for the warming of the oceans, storm systems tend to feed off of the energy provided by warmer surface temperatures and this is thought to mainly affect the intensity of winds associated with tropical cyclones (Anthes, 2016). Both the gradual rise of sea levels and the warming of sea surface temperatures are key components of climate change but are also considered to be the two fundamental elements of the amplification of storm surge which is correlated to the intensity of tropical cyclones (Karim & Mimura, 2008). The information provided shows how the worsening of climatic effects is currently playing a role in the severity of tropical cyclones and projections indicate that this trend will continue into the foreseeable future.

Although depicting future scenarios can pose challenges, scientists have relatively high levels of confidence regarding the intensity of tropical cyclones going forward. Various studies have yielded similar results leading researchers to strongly believe that tropical cyclone intensity will increase significantly for future storms (Knutson et al., 2020). Increasing intensity indicates a higher probability of category 3 and higher storms as a result of the exacerbation of climatic factors (Knutson et al., 2020) Being the most devastating of cyclones in terms of physical devastation and the resulting death tolls (Knutson et al., 2020), there are major concerns going forward for vulnerable countries. Further studies have also explored this trend of intensity; scholars have used hydrodynamic models to predict the extent of inundation from meteorological systems

that produce intense storm surge (Karim & Mimura, 2008). The findings of the study conducted by Karim & Mimura indicate that the magnitude of storm surge plays a key role in flood depth and the area of inundation resulting from tropical storms and their work further demonstrates that there is a connection between the effects of climate change and the intensity of tropical cyclones (Karim & Mimura, 2008). Other studies have yielded similar results, such as the work of Knutson et al. In gathering information from a variety of scientific authors in the field, they found that the vast majority of scientists demonstrated a level of confidence as to the connection between climatic factors and future tropical cyclones (Knutson et al., 2020). While this relationship requires additional research from both the meteorological and environmental fields in order to be more clearly identifiable, we can use this information to associate the impacts of climate change with the disaster management arena.

International Efforts

With the growth of concern regarding disaster risk reduction for vulnerable nations, international policy has become increasingly important in providing relevant frameworks for disaster mitigation strategies. In the effort to address global disaster risk, the United Nations Office for Disaster Risk Reduction (UNDRR) established the Hyogo Framework for Action (HFA) in 2005, one of the first international frameworks to be signed and implemented by numerous states (Basher, 2008). The main objectives of the HFA are focused on reducing impacts from natural disasters and ensuring favorable conditions for communities in the process (UNDRR, 2007). Achieving such goals requires several key features, most notably ensuring that disaster risk reduction is a

priority at all levels of governance while improving overall disaster preparedness (UNDRR, 2007). The implementation of the Hyogo Framework was a crucial action in international environmental policy because it not only provided direction for states commonly affected by natural disasters over the years but it helped develop an initiative for vulnerable countries that had not existed before. The HFA also called for the utilization of risk reduction strategies into all components of society for communities; for example, all features of sustainable development were required to address risk reduction especially in coastal regions where hydro meteorological disasters are more frequent (UNDRR, 2007). The formation of the Hyogo Framework was a crucial step in the disaster management field, but given the nature of the field, updates were required.

Following further review of the Hyogo Framework, the UN later proposed the Sendai Framework, an enhancement of the previous guidelines for risk reduction of natural disasters. The main goal of this framework was to address the failures that were present in the HFA, the most noteworthy being the repeated degradation of social systems in vulnerable regions as well as the continuous increase in global disaster-based mortality (UNDRR, 2015). However, the Sendai Framework appeared to aim considerable attention at the inequalities that exist globally, both environmental and social. As scholars have argued that global disaster risk reduction should focus more on developing nations that are intrinsically vulnerable to the effects of severe disasters (Ahamed, 2013). The Sendai Framework addressed such concerns by putting priority on not just reducing existing risk but preventing the accumulation of additional risk through environmental inequities (UNDRR, 2015). Reducing inequities that increase disaster-based risk were

delegated to all levels of governance for states (UNDRR, 2015), yet there is still some uncertainty with how states should incorporate such aspects of disaster risk reduction. Despite the notable improvements in recognition of disaster planning and mitigation by participating states in the years following the proposal of the Sendai Framework, there remains an apparent struggle in determining which sectors of government should be actively engaged in disaster management policy.

Given the variety of perspectives that are present regarding disaster adaptation strategies, there is a need to identify key factors that can help scholars analyze the effectiveness of particular approaches. Without the identification of key factors, it can be difficult to analyze disaster events as case studies in this context contain numerous unique components. As a result, there is a need to reduce uncertainty in the disaster management literature more broadly (Basher, 2008). The next section will introduce three major factors that must be considered in all aspects of disaster management: risk assessment, response effectiveness, and disaster complexity. Each factor will be described in broader context which will help set up later sections of this paper, where the factors will be analyzed in specific case studies.

A. Factors

Risk Assessment

One of the fundamental elements of disaster management consists of efforts to reduce disaster based risk for communities (Shikada et al., 2012). However, in order to effectively reduce risk, it is essential that responsible parties identify areas of concern in a variety of sectors. One area is the geographical or physical vulnerability where coastal regions or zones that are low-lying or surrounded by bodies of water and are susceptible to inundation from major cyclones (Webster, 2008). The physical or geographical vulnerability of a region is generally unambiguous as an abundance of research exists from previous decades that has displayed certain geographic regions that are vulnerable in the context of climate change (Cutter et al., 2008). Another key method requires the investigation of social vulnerabilities that exist within communities which can greatly affect a community's level of risk regarding disasters. Social vulnerabilities are classified as a product of social inequalities that are present within a society and can be a product of various factors such as age, sex, and income for households within a community (Cutter et al., 2003). The main consideration for social vulnerabilities is the economic situation within a community which is often a key factor in disaster risk analysis (Cutter et al., 2003). Economic deficiencies are of the greatest concern as the inability to increase expenditures on protective infrastructure as well as the lack of resources to address a disaster event after it occurs can severely interfere with a nation's disaster adaptation efforts (Basher, 2008). Using these key components, researchers are

able to identify potential vulnerabilities which then allows them to effectively assess the risk a nation or community possesses with respect to the likelihood of occurrence of a particular disaster.

The identification of risk can often be inhibited by the disconnect between the assessment of risk by professionals and the actual perception of risk by communities of concern. The ways in which humans perceive risk can ultimately shape their response to whatever event manifests potential danger. Although risk assessments are used by governing bodies to determine vulnerabilities among populations, risk perceptions are solely based on psychological judgments of individuals based on the perceived reality that an event will occur and affect the individual (Gierlach et al., 2010). There are numerous factors that may affect the risk perceptions of populations but there remains uncertainty regarding which factors are most crucial especially concerning the aspects of preparedness and response to natural disasters. Some argue that social behavior, which highlights individual awareness through personal experiences of natural disasters, is the most significant factor in shaping risk perceptions for individuals (Wachinger et al., 2013). Other studies claim that geographical location and proximity to perceived threats constructs perceptions of risk for communities; therefore, it is anticipated that regions that are vulnerable to specific disasters are more aware of the risk that is present (Gierlach et al., 2010). The consistency in these studies demonstrates the idea that different communities may perceive risk differently with respect to natural disasters due to a substantial amount of factors that are all related to cultural diversification between countries.

Response Effectiveness

The preparation stages of disaster events are often analyzed in greater detail than the later stages, however failing to analyze the response of the party in control can exclude an essential component of a particular case study. While risk assessments should generally take place prior to a disaster event, the vulnerabilities that are identified can still play a significant role in response efforts. Social vulnerabilities, for example, can essentially shape the outcome of disasters, so researchers often make the claim that social indicators should be of highest concern, more so than physical vulnerabilities (Ahamed, 2013). The economic dependence of a society has also been studied and findings indicate that relative wealth of households within a vulnerable community is directly linked to the overarching resilience of a community (Cutter et al., 2003). This connection between economic systems and the long-term resilience of a community following a disaster implies that response strategies are very much affected by the level of risk for a given population which could have implications for the efficacy of response efforts. It is clear that in order to achieve an efficient level of response from a governing body or other responsible party, pre-disaster preparation should be a major concern (Azad et al., 2019), yet government intervention during and following an event is inevitable, so it is important that there is an understanding of the primary examples of response approaches during these phases.

Examples of response strategies are relatively one dimensional in that many countries adopt similar methods of viewing response procedures. A key consideration for disaster management comes in the form of aid and its distribution to afflicted

communities following a disaster event (Kapucu, 2011). Relief operations are often complex as there can be various actors involved at both the national and international levels (Mahmud & Barbier, 2016). The introduction of additional actors can introduce a diversity in motives and main concerns among stakeholders; for example, a national government's approach to aid distribution may differ greatly from that of an international organization such as the UN, so the interactions between stakeholders can, in some cases, hinder the response procedures within a given nation (Kapucu, 2011). Issues with response effectiveness can also arise within a single state as community based approaches to disaster management can involve numerous actors at the local and national levels, and if there is a failure to collaborate or drastically different interests exist, response can be delayed significantly (Azad et al., 2019). While one can conceive numerous ways of analyzing the response efficacy factor, the method of analysis for this study will be addressed in the Discussion of Analytical Criteria section.

Event Complexity

Another major consideration in disaster management research comes from the disasters themselves. Natural disasters come in many different forms which may further complicate the methodological procedures that are outlined by researchers in this field. Different disasters present their own unique collections of problems for national governments in preparation and response schemes, ultimately shaping response strategies based on the specific disaster (Coskun et al., 2011). An example of this complexity appears in a study of the international disasters of Cyclone Nargis in Myanmar, which is used in this study, and the Sichuan Earthquake that struck China (Kapucu, 2011). Not

only are the disasters being evaluated highly intricate in themselves but they are two completely different types of natural disasters which can influence the results of analysis. Despite the challenges shown in this example, Kapucu is able to assess common international disaster management approaches and offer input on the issues regarding the distribution of power to international organizations as well as domestic governing bodies. Event complexity can play a powerful role in limiting progress in this field, yet the collective understanding regarding disaster risk and the necessity to address vulnerability has resulted in considerable progress in terms of risk assessments and further examination into this topic.

The ultimate goal of the event complexity factor is to offer insight into a nation's ability to adapt to a disaster event. This factor is very relevant in the context of the other two factors of risk assessment and response effectiveness. The determination of a nation's disaster capacity is a major aspect of this factor, however this a level of uncertainty here as well. The other fundamental component of the event complexity factor is the consideration of hypothetical scenarios, where scholars must consider the intensity of certain disasters as so severe to the extent that efforts to address the issue will always be insufficient. It is for this reason that the event complexity factor is more of a consideration for scholars than a measurable system. A potential criticism of this framework is relevant in the connections with climate change because, as previously discussed, natural disasters, specifically tropical cyclones, are directly linked to climate change, which can be considered anthropogenic and directly caused by humans. If the intensity of certain disasters can be linked to climate change more directly, so this

introduces a potential paradox that limits the framework. While this factors needs to be updated by scholars in the disaster management field, we can use event complexity as a form of reflection following an in depth analysis of case studies.

B. Approaches to Disaster Management

After introducing the factors that are attributable to the magnitude of the impacts of natural disasters, it is worth discussing the disaster management sector and the strategies that have been developed and analyzed by scholars. It is first worth noting that different states have different political systems that offer unique challenges, so when examining domestic disaster management scholars are speaking quite generally. However, it is apparent that in most cases, domestic management is reliant on different sectors of government because climate change related issues are often viewed as concerns that should be managed by scientific sectors and the threat of natural disasters is generally handled by civil sectors or a separate disaster mitigation domain if it exists within a state's administration (Basher, 2008). The problem with this distribution of authority is that, as discussed earlier, climate change and natural disasters are very much related and keeping the two matters separate allows for inconsistencies in effective management. This question of who should get involved has sparked attention among scholars in the disaster management field who have developed specific regimes that address the distribution of responsibilities. Some scholars agree that a policy approach that involves shared responsibility between sectors of governance is most effective, or in

other words, all aspects of society must play a role in disaster adaptation and management (Atkinson & Curnin, 2020). Other arguments take this framework further and claim that the unification of civil sectors and scientific departments within governing bodies allows for the implementation of varying perspectives which is beneficial for community resilience (Basher, 2008). However, some scholars believe that the integration of different sectors actually hinders disaster mitigation policy as the inclusion of different actors adds unnecessary complexity to disaster management, thus opponents would favor reduction in diversification of authoritative agencies (Kapucu, 2011). The disagreement among researchers in disaster management shows the need for further analysis of effective policy regimes in this field.

Research in the disaster management field has grown tremendously in recent years and a wide variety of policy approaches have been discussed. Much of what has been studied by scholars is centralized on preparedness of states and emergency preparation that is provided by governing bodies. Yet, in the disaster management field, it is apparent that there remains considerable uncertainty regarding the actors in preparedness and response regimes and which methods are most effective. Additionally, the idea of responsibility is seemingly excluded from debates as research tends to examine the role of government authority in disaster mitigation but fails to address key actors in such efforts. Historically, federal governments and governing bodies have been held accountable for the overall preparedness of communities with respect to natural disasters but in many countries such bureaucracies do not have the capacity to effectively manage disaster mitigation (Azad et al., 2019). For example, developing countries which

are more commonly affected by the natural disasters generally do not have sufficient resources and proper infrastructure to rescue disaster-based risk for vulnerable communities; thus it can be argued that their respective national governments should not entirely be held accountable (O'Brien et al., 2006). To what extent governing bodies should be responsible for proper disaster mitigation for its citizens remains unclear, however scholars have introduced various approaches that can potentially improve disaster management for vulnerable countries.

Based on the information provided, the approaches to disaster management can be divided into two separate, contrasting categories: top-down vs bottom-up approaches. Although both the terminology and the categorization of these approaches have not been directly identified in this field, there is a clear distinction between the two different methods of addressing natural disasters from the perspective of a national government. These different categories will be analyzed in later sections with specific case studies of strategies being used from both subjects. The next subsection describes the primary components of both categories of approaches while also offering the most prominent examples that are present in modern disaster management. Examining both categories of approaches helps demonstrate the significant distinctions between the two while also indicating the potential advantages and disadvantages of the implementation of the different strategies into disaster adaptation efforts.

Top-down Approaches

Traditional disaster management policy approaches have generally been predicated on a 'command and control' method of governance, fully entrusting national governance while withholding responsibility from communities and local governments (Scolobig et al., 2015). This hierarchical model inherently excludes participation from non-governmental actors and thus local populations as well, and much of the objectives of the top-down approach favor reduced complexity in government response to natural disasters. The top-down approach is also centered around authorities and elites, where the concept is that such actors possess the knowledge and capacity to effectively manage the impacts of natural disasters while also ensuring the protection of local populations (Scolobig et al., 2015). The top-down approach essentially labels communities as receivers of information with the justification being that authorities have the capacity to address disaster risks while vulnerable populations unsuited to play an active role in disaster management (Scolobig et al., 2015). Yet, while this model was widely adopted into the 21st century, many scholars began to question the legitimacy of the assumptions upon which the top-down approach was founded. Further examination of the approach has led to a variety of criticisms and the uncovering of significant defects in the framework.

The disaster management field has undergone many changes in recent years due to the increased awareness of the impacts of natural disasters and the recognition of the necessity to mitigate such effects. Historically, disaster management literature has generally favored the top-down approach in the implementation of mitigation strategies as the prevailing thought was that national governments generally possess the resources

to respond effectively to natural disasters, however there have been two notable shifts that resulted in a transformation in large scale policy initiatives. Following the development of the HFA, there was a noticeable divergence from the previous frameworks which were concentrated on response rather than preparation, therefore scholars began targeting precautionary measures that countries could enforce with respect to natural disasters. The considerations displayed were attributed to the concerns regarding disaster based mortality and the alarming escalation of natural disasters globally in the 21st century, with the idea being that waiting for disasters to occur was not satisfactory especially considering the intensification of climate change that was evident. Years later, there was another shift, one predicated on the course of action with governance, with scholars increasingly asserting the notion that the commonly established hierarchical structures contain significant flaws in disaster management (Kapucu, 2011). There was also growing concern regarding the idea of authority from a distinct actor as the reliance on a single governing body introduces the possibility for corruption and mismanagement (Kapucu, 2011). With the development of interest in disaster management globally, the matter was debated heavily to the point where questions arose regarding the efficacy of the traditional approach. As a result, we have seen massive changes in the disaster management field in recent years with efforts to develop new strategies that would ultimately transform the entire discipline.

Bottom-up Approaches

Determining who is accountable in disaster management has proven to be a difficult task in environmental policy, however increasing research in the field has

delivered alternate approaches to the issues present. One method that has become quite favorable among scholars is the idea of Community-Based Disaster Management (CBDM), where the focus is on connecting vulnerable communities to governing bodies through risk reduction of common disaster events for specific countries (Azad et al., 2019). By distributing more authority to communities not only are vulnerable populations more involved in policy processes but communities as a whole are able to assess their own risk which often is more effective than assessments from governing bodies that may be unaware of specific impacts and the magnitude of such impacts (Azad et al., 2019). This framework is important because unlike previous top-down approaches, CBDM puts more emphasis on preparation at the community level and therefore there is less reliance on the actions of relevant governing bodies (Azad et al., 2019). CBDM approaches prevent vulnerable communities from being neglected in disaster management policy which can be a major issue considering such communities possess the most risk for severe disaster outcomes. Scholars argue that the implementation of Community-Based Disaster Management will provide more clarity for countries that struggle to mitigate the threat of disasters and as a result will improve preparation efforts through community participation (Azad et al., 2019). However, despite the confidence from some scholars, others have pointed out noticeable flaws in the CBDM policy approach.

As mentioned prior, policy approaches for disaster mitigation can be problematic because states usually have their own unique challenges in addressing vulnerabilities. The common theme for regions being analyzed in this field is that they generally lack the

resources and infrastructure to effectively implement the strategies in the CBDM framework. For example, the establishment of cyclone shelters and other defensive expenditures at the community level requires assistance from governing bodies which contradicts CBDM strategies (Mahmud & Barbier, 2016). Some scholars argue for a more holistic approach that relies more on international governance where there is greater collective capacity to respond to disasters (Haque et al., 2012). While the economic situation for vulnerable states can restrict policy approaches, actors must find ways to incorporate disaster risk reduction strategies into political regimes. Further, communities are inherently complicated entities, especially in developing countries where power struggles and social inequalities can limit governance tactics (Azad et al., 2019). A prime example of these complexities and their implications for governance are present in the case studies being utilized in this study.

Additional concerns in the CBDM framework are raised when incorporating actors from the NGO sector. Much of the bottom-up style of governance is predicated on the inclusion of NGOs that intervene at the community level and play a role in the implementation of risk reduction strategies for communities (Azad et al., 2019). Yet, although such organizations are meant to strengthen community resilience and aim to reduce disaster based risk, issues can arise in the integration of multiple actors. Since the inclusion of NGOs in CBDM requires an aspect of institutional partnerships that are dependent on effective cooperation between the organizations and governing bodies, both local and national, the framework can lead to failure if collaboration is not efficient (Khan & Rahman, 2007). While some scholars have argued that the only way forward in

disaster management is through collaboration efforts between public institutions and governments (Basher, 2008), others claim that this institutionalization aspect only complicates the bottom-up approach through the involvement of a diverse body of actors with specialized interests (Kapucu, 2011). There have also been cases where a lack of transparency with NGOs has hindered disaster mitigation, particularly through response efforts (Khan & Rahman, 2007). NGOs intrinsically possess their own unique political bias and agendas which at times inhibits successful collaboration or in extreme cases can introduce the opportunity for corruption at the community level (Khan & Rahman, 2007). It is for these reasons that the CBDM framework has been examined frequently as it possesses key features that theoretically would greatly benefit communities in disaster risk reduction, but there are weaknesses that must be addressed, thus the framework can be considered a work-in-progress.

While the bottom-up approach that has been discussed can present complications in disaster preparedness, there is an overarching theme that researchers have acknowledged as beneficial for countries going forward. The fundamental principle of community-based management is the idea that communities are more aware of the risks they face than national governments and thus they should possess a level of authority (Azad et al., 2019). The methodology also stresses the need for people-centered policy approaches which would further depart from the top-down approaches that have dominated the disaster management discourse. (Azad et al., 2019). Although the purpose of the CBDM framework is to address the problems regarding disaster mitigation, the schemes provided ultimately aim to construct an alternate perception of

the demand for community resilience. By putting greater emphasis on individual security, scholars believe that the methodologies will have the ability to highlight the true rationale for disaster mitigation, as it indicates that the intentions of disaster management should truly aim to benefit people, rather than government entities (Ahamed, 2013). In placing populations at the forefront rather than government stability, researchers are confident that not only will the effects of disasters be minimized greatly, but the principle of people-centered management can be introduced in other fields, on a macro level.

3. Methods

With the case of natural disasters, case study analyses tend to be an effective method in uncovering flaws in government preparedness and in some cases can lead to comprehensive critiques of a specific country's disaster mitigation system. However, this methodology can sometimes fail in addressing disaster mitigation efforts on a larger scale as the emphasis is put solely on a single state's political system and thus any policy recommendations that arise may only be applicable to the state being studied. For this reason, a comparative case study approach is much more effective in determining which disaster mitigation strategies are favorable for vulnerable states as comparing different countries allows for substantial analysis and comparisons that would be impossible in other approaches such as the analysis of a single case study. Comparing different states in their response mechanisms also allows us to identify the major factors that either inhibit or promote disaster response efforts in more general terms. Studies that focus on a

single case study are beneficial in exploring the specific factors present in the state being explored but it can be difficult to make conclusions regarding disaster mitigation on a greater magnitude.

This study focuses on the countries of Bangladesh and Myanmar, both situated in southeastern Asia along the Bay of Bengal. Mainly due to its geographic characteristics, this region is largely accustomed to frequent natural disasters, most notably tropical cyclones (Alam & Dominey-Howes, 2015). Both nations are considered highly vulnerable to inundation produced by tropical cyclones because of the extensive low-lying regions present along coastal areas (Mahmud & Barbier, 2016). The Bay of Bengal has been studied greatly by scholars because the effects of climate change are quite apparent already unlike other regions where the impacts are not as noticeable. Even without the amplification of climatic effects, the Bay of Bengal has relatively warm waters, most notably in the spring months, making it a hot spot for the formation of cyclones which are generally of higher magnitude (Alam & Dominey-Howes, 2015). Furthermore, the diminished stability of the vertical wind shear, changes in the wind direction and speed with changes in altitude, during the spring months combined with the relatively warm sea surface temperatures provides ideal conditions for the formation of intense tropical cyclones (Webster, 2008). The combination of physical vulnerability in the form of low-lying coastal regions and social vulnerability of mostly poor populations residing in areas situated on the Bay of Bengal creates a major hazard for local communities. The extent of the vulnerabilities present in this region demonstrates the significance of effective disaster management policy and by addressing these issues

countries will be better equipped to mitigate the effects of natural disasters, particularly tropical cyclones, reducing the impact on communities that are susceptible to such events.

This paper will use a comparative case study approach using the cases of Cyclone Sidr (2007) in Bangladesh and Cyclone Nargis (2008) in Myanmar. The cases in this study were selected based on a number of factors that were highlighted in previous sections based on prior research. I found it necessary to utilize two countries that are exceptionally vulnerable to tropical cyclones and experience such events annually; choosing countries that do not experience a high frequency of tropical cyclones would diminish the validity of potential conclusions that form. For example, choosing nations that very rarely experience cyclonic activity would make it difficult to make assumptions based on findings as there would be questions as to the value of putting significant resources into an issue that is not as common. It is also worth noting that both Bangladesh and Myanmar are located in southeast Asia and are situated next to each other along the Bay of Bengal. Since tropical cyclone literature suggests that different regions may experience unique outcomes for cyclone frequency intensity due to differential warming of the planet (Knutson et al., 2020), selecting countries in the same region mitigates this potential issue. Further, the Bay of Bengal is arguably the most vulnerable region to the effects of climate change due to the geographical location but also the social vulnerabilities that are present, specifically in the economic sector. Although Bangladesh has been experiencing economic growth in recent years and Myanmar remains stagnant, this study is focusing on case studies from 2007 and 2008, where the respective per capita GDPs were much more comparable: Bangladesh's per

capita GDP in 2007 was approaching \$700 compared to Myanmar's which was approaching \$650 (International Monetary Fund, 2019). It is also worth noting that the economic comparison introduced here is not a very accurate representation of the communities being examined in this study, despite the steady increase in GDP in Bangladesh in recent years, a large portion of the country remains impoverished. These concerns will be considered when conducting this study.

4. Discussion of Analytic Criteria

Using the case studies mentioned in the previous section, specific analytic criteria will be used to evaluate the effectiveness of policy approaches used in both Bangladesh and Myanmar. The factors discussed in previous section will be analyzed in both case studies. The major factors outlined in this paper are risk assessments at the appropriate unit of analysis, the efficacy of response strategies, and the consideration of event complexity. All three of these factors will be revisited in the analysis section following the introduction of both case studies. Each factor will be examined for each case study given the circumstances of the event so that general findings can be discussed in the discussion section. It is important to note that these factors can be broad with respect to the analytical processes required, so there will be multiple methods of investigation for each factor as demonstrated below:

- **Risk Assessment:** Will be analyzed by identifying risk assessments (if they are present) prior to the disaster. This analysis will require an examination of the

actions taken by the stakeholder being investigation, for example any efforts to raise awareness of the vulnerabilities that exist. Determining risk and vulnerability will also be crucial here, so a general risk assessment will be conducted for each nation regardless.

- **Response Effectiveness:** Determination of whether or not a nation's approach was effective requires a review of the nation's capacity to address disasters and then an analysis of the actual mechanisms employed during and after the disaster. Community resilience will also be acknowledged briefly to make connections between the disaster and modern day implications of the adopted approach.
- **Disaster Complexity:** Complexity of the disasters, in this case tropical cyclones, will be addressed in the discussion section, although it is a factor for analysis. The determination of the degree of complexity will be addressed based on the findings relative to the first two factors and thus discussion of event complexity will consist of more broad, theoretical connections.

The three factors outlined in this paper will be used to analyze the two main forms of approach to disaster adaptation. The contrasting approaches of top-down vs bottom-up approaches will be identified using the comparative case study analysis and thus the three main factors will be examined for each case study, which can be considered an application of the factors to the different policy approaches. The succeeding case study section will consist of an introduction to the countries being analyzed, followed by the specific case studies of tropical cyclones.

5. Case Studies

A. Bangladesh

Bangladesh is a country commonly studied by scholars with respect to climate change and other environmental fields due to it being a highly vulnerable nation which can be attributed to many different factors. Bangladesh is one of the most densely populated countries in the world with roughly 160 million people located within less than 60,000 square miles and scarcity of land is a growing problem (Lewis, 2011).

Bangladesh is a coastal nation that is well known for its considerable vulnerability with respect to disaster events. With the Himalayan Mountains to the north, major rivers flow through the center of the country and into the Bay of Bengal, forming the massive delta for which the country is known. The combination of this natural deltaic landscape and the remarkably low-lying lands make Bangladesh extremely flood prone (Lewis, 2011).

Economically, Bangladesh can be considered an agrarian country as 60% of the labor force is in the agricultural sector which accounts for nearly a quarter of the nation's GDP (Lewis, 2011). The geographical characteristics of Bangladesh allow for high agricultural productivity and thus cultivation is a major aspect of not only the nation's economy but the livelihoods of local communities. While the nation's per capita GDP has increased steadily over the last few decades with an equivalent of roughly \$9,000 in 2007, there were still considerable inequalities between the rural and urban regions (World Bank, 2020). Bangladesh's massive population combined with high poverty in rural regions accounts for the social vulnerabilities present which are only heightened by the physical vulnerabilities of the nation.

Bangladesh is quite vulnerable to natural disasters for many different reasons, but much of this is related to the climate in this region. In the Bay of Bengal, the months of June through October account for what is known as the monsoon season, characterized by extremely heavy rainfall and annual cyclonic events that together produce the majority of the annual rainfall for the country (Naz et al., 2018). It is common for Bangladesh to experience numerous tropical cyclones throughout the monsoon season and in many cases this can include very intense storms such as category 4 or 5 cyclones which can produce adverse effects for local populations. The most severe impacts are felt with respect to agriculture as heavy floods can decimate crops and drastically decrease the fertility of soil in rural settlements (Naz et al., 2017). The Bay of Bengal also possesses unique geographical characteristics that promote the amplification of storm surge, for example its shallow, but wide continental shelf, making coastal regions more susceptible to flooding (Hossain et al., 2008). Due to its location and geography, Bangladesh has received significant attention in the disaster management field, yet effectively mitigating the inherent risk that exists is contingent on political stability and proper governance, which is rarely present in developing countries.

Bangladesh is considered a democratic republic with two dominant domains at the national and local levels (CLGF, 2017). The administrative geography of Bangladesh is quite complex as there are 8 main divisions throughout the country, 64 districts and hundreds of sub-districts known as Upazilas (CLGF, 2017). There are lower tiers beyond the Upazila districts consisting of unions, villages, municipalities and other communities which function through the aforementioned districts (CLGF, 2017). Upazilas are

considered to be the most productive level of local government in Bangladesh as national policies are enforced through these administrative bodies and thus have considerable authority in disaster management (Nadiruzzaman & Wrathall, 2015). Bangladesh is also well known for the numerous NGOs present in communities which has added to the decentralization of power from the national government (Lewis, 2011). NGOs seemingly have significant authority at the local administrative level so there is considerably less reliance on the national government for the management of public policy in the upazilas and their respective unions. Some of the issues however with the incorporation of such agencies stem from the lack of funding from the government of Bangladesh as the national government manages the disaster relief fund and its allocation, which is dependent on a rapidly changing economy in the country (Nadiruzzaman & Wrathall, 2015). Not only is the collaboration of NGOs and communities difficult to accomplish but it should not be assumed that populations will always be willing to, or in some cases, be able comply with disaster preparation efforts and risk reduction schemes.

While governance in Bangladesh is inherently complicated, compliance from communities has its own unique issues. Much has been studied about the patronage politics of Bangladesh where the societies are organized through various networks of patron-client connections where wealthier individuals with political power often manipulate poor households through economic incentives (Lewis, 2011). The complexity of such relations present poses major consequences for governance, specifically collective action and the work of public institutions that are necessary in disaster mitigation (Lewis, 2011). Scholars in the disaster management field have criticized the

national government of Bangladesh for the marginalization that exists between the rich and poor in communities and that collective response efforts between the government and relevant stakeholders and NGOs does not address the underlying issues regarding patronage (Nadiruzzaman & Wrathall, 2015). The aspects of civil society in Bangladesh have allowed for corruption in vulnerable communities and the disparities in capacity to prepare for natural disasters remains a major issue for the country. Additionally, the conditions of marginalization at the local level can further obscure the necessity to comply with regulations imposed by governing bodies in disaster mitigation efforts which only increases the vulnerability of those populations.

Due to the frequency of the occurrence of natural disasters in Bangladesh, most notably tropical cyclones, there has been a discernible shift towards nation-wide disaster mitigation efforts. Bangladesh is well-known for its wide variety of non-governmental organizations, many of which are actively involved in the nation's public policy sector which often addresses the emergency planning for tropical cyclones (Lewis, 2011). Specifically, NGOs are actively involved in engaging vulnerable communities through cyclone preparedness programs which educate citizens and increase awareness with respect to risk (Hossain et al., 2008). The incorporation of NGOs is focused on assisting rural regions that do not have similar supervision in comparison to urban areas such as within the Dhaka region (Hossain et al., 2008). Based on the approach here, we can consider Bangladesh's governance favoring a community-based approach because, although not perfect, the focus is on working from the local levels and up, so it is essentially a bottom-up strategy.

Although there are still numerous social and political concerns in Bangladesh, particularly in the rural regions which account for the majority of the country, recent shifts in policy approaches by the government of Bangladesh have greatly reduced the overall risk and vulnerability of the nation as a whole. The national government has made considerable transformations to its disaster mitigation operations, most notably the shift towards collaborative governance with the inclusion of institutional partnerships between stakeholders and vulnerable communities (Haque et al., 2015). Stakeholders here are commonly the national government itself, communities and local administrations (upazilas), but can also include academia, the private sector and intervention from neighboring countries such as India which has a greater capacity to respond (Haque et al., 2015). Much of the focus with this approach uses principles from the CBDM framework which is rather ubiquitous in public policy initiatives developed by Bangladesh in the years leading up to Cyclone Sidr in 2007. The nation's disaster management sector had also adopted many of the propositions presented in the Sendai Framework, for example the strengthening of vulnerable communities through initiatives centered around empowering populations that are highly susceptible to the effects of tropical cyclones (UNDRR, 2015). The progress made in the minimization of disaster risk, particularly at the community level, indicates a level of flexibility from the national government with respect to international compliance which can play a major role in the prevention of hazardous outcomes at all levels. The shift in policy approaches also shows a level of awareness of the nation's unique disaster risk that exists which is a crucial step in disaster mitigation.

There are many examples that display the efforts to reduce risk for disasters by the Government of Bangladesh and active stakeholders. There were noticeable improvements to physical infrastructure in the years leading up to Cyclone Sidr in 2007; for instance, the construction of physical embankments in coastal regions as well as the augmentation of previous embankments that degraded over the years (Paul, 2009). Not only are man-made barriers effective in cyclone risk reduction but natural barriers can be equally, if not more important. Bangladesh's southeastern coast is home to a large mangrove forest known as the Sundarbans which plays a major role in consuming storm surge which can reduce the intensity of cyclones as they make landfall (Paul, 2009). While deforestation of these essential forests was prominent in the 20th century, the GOB had taken actions to significantly reduce the removal of the landscape which has been thought to decrease vulnerability in recent years (Mahmud & Barbier, 2016). Other precautions are based on the formation of cyclone shelters in coastal regions and ensuring that they are accessible to all communities (Mahmud & Barbier, 2016). While the actions that have taken place leave much to be desired for vulnerable populations, Bangladesh's endeavors in country-wide disaster mitigation have garnered attention internationally and the nation has been recognized as one of the few developing countries to seriously consider risk reduction despite its lack of capacity compared to other nations.

Cyclone Sidr

In early November of 2007, a powerful tropical disturbance was observed near the Andaman Islands in the Bay of Bengal and heading north towards the coastal regions of India and Bangladesh. After deeming the system would only intensify over the warm

waters in the bay, the Bangladesh Meteorological Department (BMD) began broadcasting nation-wide cyclone advisories and began working with the Government of Bangladesh and agencies in the disaster management sector to start planning for evacuations of vulnerable districts (GOB, 2008). As expected, the disturbance rapidly intensified into a tropical cyclone as it approached the coastline and was later identified as tropical cyclone Sidr. In collaboration with the Upazila administrative regions, the Government of Bangladesh promptly called for large scale evacuations of coastal communities and worked with various NGOs to assist citizens into accessing cyclone shelters (GOB, 2008, Paul, 2009). Although the national government mandated various preventative measures, the objective was to put more emphasis on reducing risk at the community level by empowering vulnerable populations in the pre-disaster phase. The precautionary actions that were in place were also very much based on the policy shift that was seen in recent years, as the GOB favored a bottom-up approach in responsibilities that featured elements of the CBDM framework.

The identification of risk and potential areas of concern was a key component of Bangladesh's disaster preparation procedure. The creation of numerous cyclone shelters and the establishment of welfare centers throughout coastal regions indicates a level of risk consideration and can be seen as risk-reduction strategies (Ahamed, 2013). Additionally, the efforts to make such shelters readily accessible for households that had limited means of travel further demonstrated actions taken place based on risk assessments at the community level (Haque et al., 2012). Yet despite the proactive

operations exhibited in Bangladesh during the risk identification phase, studies found that there were still not enough shelters to accommodate all households in certain communities (Paul, 2009). Further, some shelters lacked the fundamental resources to take in as many families as suggested by authorities and issues with safety and sustainability of the shelters during an intense cyclone came into question (Haque et al., 2012). While the assessment of risk was evident in Bangladesh's procedures, the efficacy of the actions taken place still did not meet the standards of the HFA leading up to Cyclone Sidr (UNDRR, 2007). Therefore, the risk assessment operations, although present, lacked some key components which would present consequences for the country as Cyclone Sidr was approaching.

On November 15, 2007, Cyclone Sidr made landfall in the southwest region of Bangladesh in the Sandurbans, a natural mangrove forest that stretches inland from the coastline (GOB, 2008). Being a category 4 storm, Cyclone Sidr was considered a major cyclonic event due to its intensity; storm surge reached heights of nearly 20 feet in the most severely affected coastal regions in southwest Bangladesh causing catastrophic flooding near the coast and river basins (GOB, 2008). Winds from the storm peaked around 150 mph which decimated the already weak foundations of homes and a large extent of damage to physical infrastructure resulted (GOB, 2008). Although Sidr officially made landfall in the Khulna district, the Barisal district and southern sections of the Dhaka district experienced catastrophic effects (GOB, 2008). A path of the storm is shown in Figure 2 below:

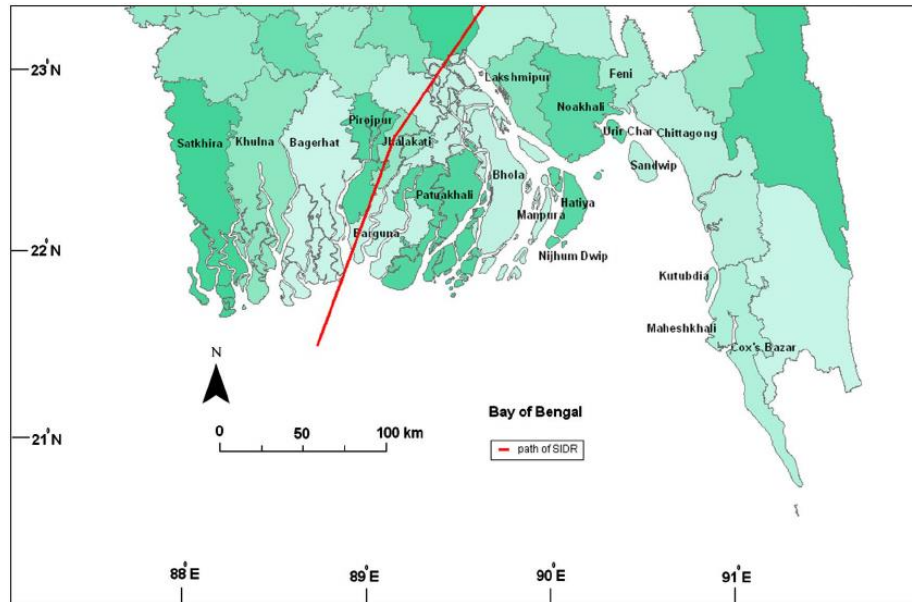


Figure 2: Cyclone Sitr Hurricane Track (Islam et al., 2011)

The vast majority of households in the affected regions are not only poor and experience considerable social vulnerabilities but many communities depend on rice cultivation for survival. The inundation of salt water combined with heavy rainfall and winds ultimately destroyed any crops that were growing as well as significantly reduced the fertility of soil following the storm (Azad et al., 2019). This had major implications for an already damaged nation as coastal communities rely heavily on agriculture for survival, so the intrusion of salt water from the storm surge not only directly damaged infrastructure but it wiped out vital crops such as rice which contributed to an increase in the death toll. Physical infrastructure in these regions was also devastated as most of the houses are self-built by households and are constructed with relatively weak materials such as bamboo and even mud (Mahmud & Barbier, 2016). The storm surge alone wiped away many homes in the coastal districts and many citizens died directly from the destruction of their homes or drowned in the surge.

Although Cyclone Sidr was extremely intense in itself, there were mitigating factors that helped prevent the exacerbation of impacts to local populations. The Sandurban forests appeared to play a major role in reducing the intensity of the cyclone, absorbing a degree of the storm surge (Paul, 2009). As the mangrove populations were heavily deforested in the 20th century, the government of Bangladesh made progress in reforestation efforts in the years leading up to Sidr, thus the government of Bangladesh and their work with NGOs on reducing vulnerability was applauded by scholars (Mahmud & Barbier, 2016, Paul, 2009). The Sandurbans were still depleted by roughly 30% which had significant implications for species diversity but also for local populations that relied greatly on natural resources that are provided by the mangroves (Hossain et al., 2008). The destruction also had long term impacts to the physical vulnerability aspect as the southwestern coastal regions were now much more exposed to cyclone-induced inundation going forward. Another mitigating factor was the implementation of physical preventative measures, most notably physical embankments along the coasts and cyclone shelters (Paul, 2009). Although some sections of embankments failed in impeding the storm surge from inundating coastal communities (Sattar & Cheung, 2019), studies show that the barriers obstructed inundation to a degree (Paul, 2009). Furthermore, Cyclone Sidr made landfall at low tide which greatly reduced the storm surge and its impacts (GOB, 2008), demonstrating an element of disaster complexity.

Due to the magnitude of devastation that occurred following Cyclone Sidr, it became clear that large scale response operations were required. International

organizations were quick to pledge assistance to Bangladesh through aid and direct relief to the most damaged regions. Humanitarian relief was managed through the collaboration of the Government of Bangladesh, the UN and other agencies that helped distribute aid to the administrative regions and from there, down to unions and villages (GOB, 2008). While international response was generally efficient, certain collaboration processes failed, most notably the participation of the Indian government which pledged assistance following the storm. Relief from India was significantly delayed as a result of the ongoing border disputes between the two nations; all the while coastal communities in Bangladesh were left without vital resources in the wake of Sidr (Azad et al., 2019). The miscommunications resulted in Bangladesh imposing a ban on relief efforts from Indian organizations at a pivotal stage of response which may have played a role in the amplification of devastation (Azad et al., 2019). The failures in collaboration between India and Bangladesh illustrate the complexity in international response and the implications of shortcomings in providing relief. The inability to successfully cooperate with India was also used to further justify the shift towards community-based disaster mitigation going forward in Bangladesh as such policy approaches can reduce complications following natural disasters.

Disaster-based mortality is often evaluated by researchers along with other measures in an attempt to uncover the true impact of a disaster event. The official death toll, although slightly controversial, is estimated at roughly 3,400 lives, which was actually quite low considering the intensity of the storm (Haque et al., 2015). Studies that compared the disaster-based mortality of previous cyclones with similar intensities that

struck Bangladesh in recent years with Cyclone Sidr yielded similar findings; the mortality following Sidr was significantly lower than that of previous cyclones (Paul, 2009). These findings suggest that there were specific mitigating factors that helped reduce the overall impact, which will be studied in later sections. As noted above, disaster-based mortality alone does not validate claims that the policy approaches were effective and this is why factors such as disaster complexity must be considered.

Despite its achievements in reducing the magnitude of devastation to local populations, the Government of Bangladesh still experienced failures in the procedures that were carried out both prior to and after the storm. Although there were considerable efforts by NGOs to increase capacity in cyclone shelters over the years, it was apparent that the shelters still could not admit all evacuees and as a result many households were turned away right before the cyclone made landfall (Paul, 2009). Some scholars attribute this issue to the massive population in Bangladesh, particularly in the coastal regions as the size of a given population is a key element of vulnerability (Cutter et al., 2008). Yet, ensuring that all individuals have access to shelters is a fundamental aspect of disaster mitigation, so there remains a level of accountability for the national government here. Further, one study suggests that within the four most devastated districts, only 40% of citizens complied with evacuations and attended cyclone shelters (Paul, 2009). These statistics illustrate that the risk reduction strategies that were implemented may not have been entirely effective as other studies have suggested. Scholars argue that the patronage politics that exist at the community level prevented the efficient distribution of resources to all households and as a result many households did not receive aid or it was delayed

significantly (Nadiruzzaman & Wrathall, 2015). The arguments here contradict the merit of the CBDM frameworks as they suggest that social vulnerabilities inhibit effective management through challenges in resource allocation.

Following the disastrous impacts associated with Cyclone Sidr, Bangladesh enacted the Disaster Management Act in 2012 which emphasized risk reduction efforts for all communities (Azad et al., 2019). The policy approach further incorporated mechanisms from the CBDM framework, most notably the intentions of improving community resilience through the empowerment of vulnerable communities (Azad et al., 2019). With measures already in place prior to Cyclone Sidr, the implementation of additional disaster risk reduction strategies demonstrates the country's awareness of disasters and willingness to take action to reduce mortality and other long-lasting effects to the livelihoods of its citizens. The motivation to increase resilience through community engagement also displays the deviation from top-down approaches that have received heavy criticism over the years and the methods observed in Bangladesh indicate a potential transformation in contemporary disaster management.

B. Myanmar

Formerly known as Burma, Myanmar is a country located in Southeast Asia, east of Bangladesh and west of China. The geographical conditions of Myanmar are very much similar to those of Bangladesh as the nation is also situated between the Bay of Bengal and the Himalayas which makes it highly susceptible to natural disasters (Shikada et al., 2012). Myanmar has experienced a wide variety of natural disasters over the years,

however cyclones specifically have not occurred as frequently as they have in neighboring countries such as Bangladesh and India. Scholars attribute this to the geographical makeup of the Bay of Bengal as tropical cyclones in this region are usually pulled west rather than east as they advance towards the northern sections, thus Myanmar has generally escaped from the worst of cyclones (Webster, 2008). Yet, this does not discount the idea that Myanmar is still considered to be one of the most vulnerable countries to tropical cyclones due to the activity of the region and the amplification of climatic effects in recent years. It is for this reason that researchers have been studying Myanmar more frequently as the various vulnerabilities that exist within the country pose major threats to communities especially without an effective disaster management plan.

Similar to Bangladesh, Myanmar's economy is also very dependent on agriculture as a result of the extremely high productivity of soil, mainly found in the deltaic regions near the coast. Rice is the most frequently grown crop due to its efficiency and as a result Myanmar's economy depends heavily on rice production and exports (Webster, 2008). As mentioned previously, the reliance on a single sector by the national government and local communities greatly increases vulnerability (Cutter et al., 2003). Further, Myanmar's Irrawaddy Delta is also home to densely populated mangrove forests which can act as a barrier to cyclonic surge and inundation, however in the years prior to Nargis there was consistent deforestation permitted by the governing body (Fritz et al., 2009). Despite the concerns displayed by scholars regarding the consequences of deforestation on an already flood-prone region, there was seemingly no consideration into restoration efforts which would have greatly reduced physical vulnerability.

Historically, Myanmar has experienced considerable political instability, much of which has stemmed from issues regarding international security. Having been involved in both domestic and international conflict over the years, Myanmar has developed a serious distrust of foreign nations, especially dominant states such as Japan and the U.S. The fear of invasion and the focus on controlling its own sovereignty has allowed for numerous other issues to be labeled as either insignificant, or if deemed serious, needed to be addressed through this overarching lens of regime preservation (Selth, 2008). Not only were there concerns regarding international security but the Myanmar Government also had fears of civil uprising and potential revolutions formed by the people of Myanmar. Social unrest had plagued Myanmar in the years leading up to Cyclone Nargis and thus the paranoia by the governing body only seemed to intensify over time and as a result it greatly hindered any implementation of effective disaster mitigation policies (Selth, 2008). Another component of the existing regime was the exclusion of NGOs and institutional partnerships in public policy, further demonstrating the top-down approach that was present in society and thus the absence of authority at the community level. The theme for the national government of Myanmar was control; by having authority in all aspects of society, they could control their people and thus maintain their security both internationally and internally.

Up until 2011, Myanmar had been ruled by a military junta known as the State Peace and Development Council (SPDC) (Roberts, 2014). Since the SPDC either directly manages or plays a significant role in all aspects of civil society, the nation's regime with respect to disaster mitigation can be considered a top-down approach,

contrasting that of Bangladesh. Not only were there concerns with the policy approach but it was evident that the existing regime's main goal was seemingly to maintain control of its people, ensuring that they oversee all social and political concerns in an attempt to prevent, as they call it, 'social instability' (Selth, 2008). For this reason, Myanmar's role in international affairs was rather troubling as the extreme distrust of international intervention put its people at higher risk for being overwhelmed by a disaster event as international response is a major aspect of disaster management, especially for developing countries. Although there were ministries and domestic organizations that governed disaster management for the nation prior to Cyclone Nargis, there was limited concern for addressing the threat of natural disasters and thus these agencies had limited funding and direction (Roberts, 2014). Without any real coordinated efforts in risk reduction strategies for communities, there was insufficient planning and preparation for disasters such as cyclones. Additionally, there was no sense of community engagement as was the case in Bangladesh with Cyclone Sidr, as the junta feared that empowering communities would lead to civil uprising and the possibility of insurrection among local populations. Although Cyclone Sidr struck prior to Cyclone Nargis in Myanmar, the national government did very little to acknowledge the impacts of a large scale disaster and some scholars have argued that this was a blown opportunity for adaptation and the protection of vulnerable communities (Webster, 2008). The stagnation that was apparent in the disaster management department was the theme for Myanmar despite the increased awareness globally of a worsening climate.

Although Myanmar formally signed and participated in the Hyogo Framework for Action guidelines, there have been major concerns with Myanmar's disaster management sector (Shikada et al., 2012). Prior to the Cyclone Nargis disaster, Myanmar did not have a country-wide communication system and thus there was no method of notifying vulnerable populations of ensuing disasters (Kapucu, 2011). This issue is much more noticeable at the community level as vulnerable populations do not have any direct access to emergency warnings provided by neighboring countries such as India, mainly due to strict governance and extensive poverty that is present. Additional concerns are exhibited with respect to evacuation procedures as prior to Cyclone Nargis there was no real evacuation system in place by the SPDC or any local level organization and a glaring lack of cyclone shelters despite the vulnerability of the region (Webster, 2008). As a result, communities in the coastal regions of the Irrawaddy Delta did not have the ability to evacuate if they were even aware of an ensuing disaster. On top of what already appeared to be a severely vulnerable region to tropical cyclones, the flaws in the disaster management sector were even more glaring. The lack of emergency planning and infrastructure indicates that Myanmar was not prepared for intense disasters in the slightest, despite being situated in a region that is recognized as being highly exposed to the effects of cyclones.

With the issues in the disaster management system, and the well-known vulnerabilities identified by scholars, it was concerning that there was limited action on the risk assessment front. Little information was obtained by researchers regarding risk identification processes completed in the top-down approach, but information related to

the inactive nature of the regime with respect to disaster risk reduction describes a glaring weakness in Myanmar prior to Cyclone Nargis (Seekins, 2009). With the military junta essentially possessing the responsibility to mandate risk assessments and a more in depth examination of the physical and social vulnerabilities that existed, actions to address disaster-based risk were, for the most part, non-existent (Zaw et al., 2012). The glaring lack of risk assessment put many communities in danger of experiencing significant hardships from the approaching Cyclone Nargis, and with the connections between risk calculations and risk perception, the inadequacy in this phase could have contributed to widening this gap (Cutter et al., 2003). More specifically, many communities in Myanmar are traditional in the ways in which locals view disaster risk (Aung-Thwin & Aung Thwin, 2013). Based on the actions of previous generations, many rural populations did not prepare for disasters such as tropical cyclones and in order to transform the judgements here, it was necessary for the national government to promote disaster risk as a key factor (Aung-Thwin & Aung Thwin, 2013). The failure to do so was a considerable weakness for the disaster adaptation system. Further, the inability to identify risk can be viewed as a limiting factor for the top-down approach displayed in Myanmar in that any efforts to address the other factors of response and event complexity would fall short without a proper risk assessment for vulnerable communities.

Cyclone Nargis

On April 27, 2008, the Indian Meteorological Department identified the rapidly intensifying system that would soon become known as Cyclone Nargis (Webster, 2008). In the days that followed it became clear that the system was developing into a severe cyclonic storm in the Bay of Bengal, but rather than follow the trends which had the cyclone tracking north to India and western Bangladesh, Cyclone Nargis took a sharp turn east as it approached the coastal regions of Myanmar near the Irrawaddy Delta. Although the Indian Meteorological Department shared the critical forecasts and cyclone warnings with the SPDC, there was seemingly limited response from Myanmar (Webster, 2008). There was additional concern from the meteorological community as Cyclone Nargis approached the Irrawaddy Delta because this region has never experienced a storm of this magnitude as previous storms were relatively inconsequential (Fritz et al., 2009). Delta basins are intrinsically susceptible to large scale floods being surrounded by bodies of water and consisting of low-lying areas but with added vulnerabilities in terms of populous communities and large scale poverty throughout, a disaster should have been anticipated prior to Nargis. For a nation that was already considered extremely vulnerable to cyclone disasters, the lack of awareness at the community level put residents at severe risk of catastrophic outcomes.

On May 2, 2008, a category 3 Cyclone Nargis made landfall on the Irrawaddy Delta in the southern regions of Myanmar, comparable with Cyclone Sidr in terms of intensity. With winds peaking above 135 mph and storm surges reaching 4 meters in some areas, the cyclone battered coastal populations located throughout the delta (Webster, 2008). Cyclone Nargis could not have struck a worse region, according to

researchers, striking a severely low-lying river delta that not only resulted in major flooding but the geographical characteristics allowed for the cyclone to maintain strength rather than dissipate rapidly, which commonly occurs once storms make landfall (Webster, 2008). A map depicting the track of the cyclone is shown in Figure 3 below:

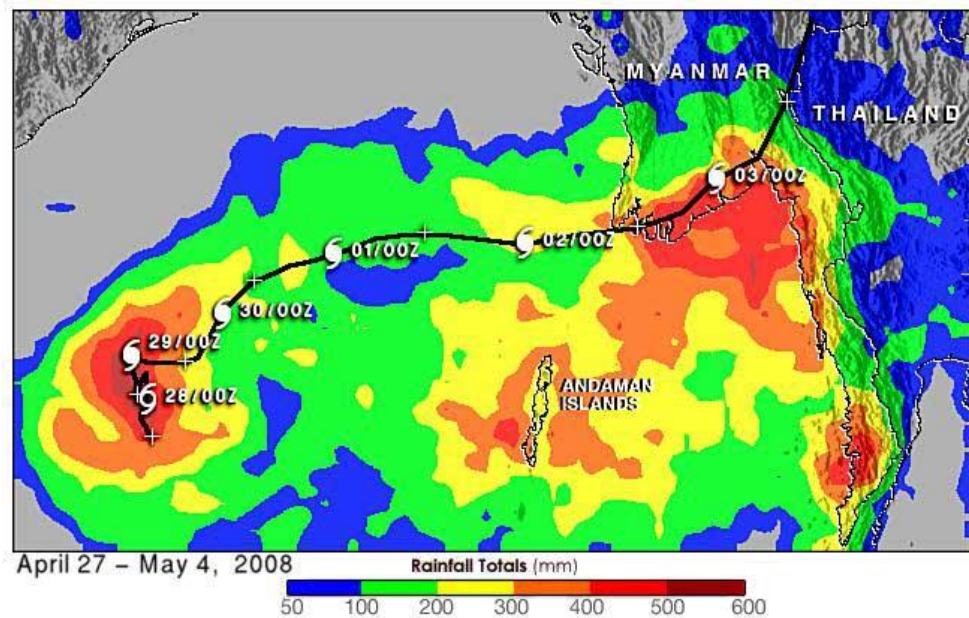


Figure 3: Track of Tropical Cyclone Nargis (NASA, 2008)

The Irrawaddy Delta experienced the most severe effects as it was left completely submerged by the overwhelming storm surge that accompanied the system. Villages and townships within the region were devastated by the cyclone as poorly constructed roads were left impassable and buildings were destroyed. Houses that were constructed with feeble foundations consisting of bamboo and low-quality wood were decimated leaving households completely exposed to the intensity of the cyclone. The lack of sufficient mangrove populations near the coast as well as the absence of physical barriers such as

embankments left entire communities exposed to inundation from the surrounding rivers and the Bay of Bengal (Webster, 2008). Long term impacts were already clear directly after the storm as vertical erosion along the coast of the Irrawaddy Delta was documented at over 1 meter and mangrove forests were completely wiped out (Webster, 2008). The aftermath of Nargis, not surprisingly, was quite significant and it became clear that a long-term recovery was looming.

Cyclone Nargis is widely considered to be the worst natural disaster to strike Myanmar in recorded history. The death toll is estimated at roughly 140,000 and an additional 2.4 million people were directly affected by the cyclone (Shikada et al., 2012). The majority of deaths were attributed to storm surge and flooding, however the death toll seemed to grow significantly in the months that followed as the extent of devastation became more clear. Large scale destruction was the theme following Nargis as farmlands, fisheries, livestock and other critical infrastructure were destroyed (Fritz et al., 2009). Salt water intrusion rapidly deteriorated wells that were relied upon by residents and the lack of agricultural infrastructure resulted in an alarming food crisis (Fritz et al., 2009). The economic impacts were estimated to exceed the equivalent of \$10 billion, making Cyclone Nargis the costliest disaster recorded in the Indian Ocean (Fritz et al., 2009). Due to the severity of the cyclone, Myanmar received considerable attention internationally as it became evident that disaster recovery would be crucial and would require many different actors. Although relief procedures were in the works following the disaster, the issues in the national government's response were visible and it was apparent that the cyclone itself was just the beginning of the disaster event.

Although international organizations pledged assistance in relief efforts following Cyclone Nargis, there were significant hurdles in efficient distribution of aid to affected regions in the Irrawaddy delta. As a result of the nation's long term security concerns, the SPDC imposed a very strict travel ban for external agencies and neighboring countries which ultimately prevented assistance directly after the storm (Kapucu, 2011). Being a member of ASEAN, only member states in the alliance were allowed entry which was ultimately useless considering such states were not actively involved in international relief in the first place. Civil society groups that were dispersed throughout the nation attempted to get involved in response but even domestic organizations were sought out after by the national government as roadblocks and blockades organized by the SPDC prevented any cooperation due to a fear of anti-state resistance from locals (Seekins, 2009). Generally speaking, disaster relief procedures are quite rapid but in the case of Cyclone Nargis, months went by and communities had limited assistance and were ultimately forced to respond themselves. The SPDC had finally allowed for the distribution of international relief weeks after Cyclone Nargis, but only under terms that they could control all operations (Selth, 2008). It became evident that not only was Myanmar dangerously unprepared for a disaster of this magnitude but the response efforts were ultimately non-existent which had major implications for populations that had no real effective means of resilience. The shortcomings of the SPDC also allude to the idea that the role of government response is crucial in reducing the impacts of a disaster and the failure to do so effectively poses hazardous outcomes to communities.

The long lasting effects following the impact of Cyclone Nargis in Myanmar were disastrous to the point that there was a fear of a second disaster; a humanitarian crisis due to the lack of vital resources such as eatable food and clean water (Seekins, 2009). Without any initial relief, many households were forced to acquire resources from streams and trenches that were either contaminated with salt water from the storm surge or polluted with deceased individuals (Seekins, 2009). Residents soon became aware of the inadequate governance by the SPDC and assistance would be delayed considerably, thus response efforts needed to come at the local level, a sense of self-resilience. Locals displayed a sense of community-based response which demonstrated that initiatives could be taken even without effective top-down governance. A major factor in preventing the potential second disaster came from the operations of Buddhist monks that acted as volunteers in the distribution of resources to affected communities (Seekins, 2009). The work of such volunteers needed to be efficient but unidentifiable by the SPDC because individuals who provided direct assistance were considered a threat and in some cases were imprisoned based on the fear of defiance by locals regarding regime security (Seekins, 2009). Not only was there an extent of mismanagement by the national government in Myanmar, but the apparent disregard for safety of local populations by the military junta indicates how the politics of a disaster can be just as important as the intensity of the disaster.

The apparent failure in managing the disastrous Cyclone Nargis by the SPDC has been studied significantly since the event in 2008. The national government, which had already been criticized previously for its authoritarian regimes, was castigated for its

apparent disregard for the well-being of local populations. Some have made claims that the SPDC favored its own security over the prosperity of civilians as a result of the troubling actions that took place following Cyclone Nargis (Seekins, 2009). Neighboring countries that had pledged assistance were outraged that they could not enter the nation during a humanitarian crisis, and some attempted to intervene without approval from the state (Selth, 2008). The justification for intervention was predicated on the idea of the responsibility to protect vulnerable populations, that the disaster was larger than the issues of sovereignty (Selth, 2008). Many international organizations started intervening without official approval from the Myanmar Government on the basis of the feeling obligated to help affected populations during a humanitarian crisis; some organizations physically entered the state without approval (Selth, 2008). Unfortunately for those that suffered, it was not until weeks after the cyclone struck that Myanmar began to acknowledge the necessity for relief procedures, well after the damage was done.

In late May of 2008, the Myanmar Government had belatedly agreed to form a joint task force with ASEAN and the UN, known as the Tripartite Core Group (TCP) (Shikada et al., 2012). The formation of the TCP was an effort to generate a level of trust between Myanmar and the UN, and the inclusion of ASEAN helped develop better relations that would prove crucial. Once the TCP was officially established, the UN wasted no time in the distribution of specialized agencies and NGOs to communities situated in the Irrawaddy Delta. The U.S. under President George Bush had pledged assistance to Myanmar, yet the SPDC was extremely hesitant to accept the services because of the prevailing fear of invasion; by allowing entry to highly influential nations

such as the U.S., it would greatly increase the capacity for local populations to revolt against the national government (Selth, 2008). Although the U.S. and other powerful nations have considered Myanmar a potentially rogue state in terms of leadership, there is no evidence that invasion would occur; thus many critics have claimed that the SPDC's regime is ludicrous and thus it would further illustrate that the focus on sovereignty over the humanitarian crisis that occurred is unreasonable and a perilous way of thinking (Selth, 2008). Others have gone as far to say that Myanmar valued state security over human security (Seekins, 2009), an attitude that asserts the notion that the national government is to blame for the outcomes. Regardless of the criticisms from different sources, Cyclone Nargis left insurmountable impacts that were not just felt in Myanmar, but were relevant globally.

The delay in relief has been one of the main components of analysis from scholars attempting to uncover the disaster-based mortality that resulted from the cyclone, yet, there were many other significant long term effects following the disaster, which may not have been preventable to a degree. The devastation of croplands in the Delta was felt for years following Cyclone Nargis as cultivation became nearly impossible for locals who relied on it for not only their own intake but for jobs as well (Seekins, 2009). Since numerous countries rely on the cultivation of rice in the Irrawaddy, there were local food shortages in neighboring countries and major economic implications outside of Myanmar (Fritz et al., 2009). However, domestic concerns continued to escalate in the years after Cyclone Nargis, and what Myanmar had feared all along was developing amongst the affected communities in the Irrawaddy, as civil unrest became prominent once again,

which only further complicated the long term-recovery efforts (Seekins, 2009). As is the case with most disasters, not only are the direct effects important but the abiding repercussions indicate the true intensity of a disaster event.

The disaster of Cyclone Nargis is one of the worst environmental tragedies in recorded history. Not only has the disaster been recognized based on the environmental impacts that followed, but there was growing interest in the disaster management field in the aftermath of Nargis, particularly the politics of a disaster. The absence of preparation and the outright apathy displayed by the SPDC received considerable attention around the world and substantial criticism from international organizations and various countries. While there was clearly an aspect of failure regarding the resulting humanitarian crisis and devastation to all sectors of society in Myanmar, the extent of failure in the policy approach is not as well understood. Myanmar's top-down approach to addressing disaster management was very much shaped by the regime demonstrated by the military junta prior to and during the disaster event, but what are the foundational issues that arise in this administrative approach? Is this method ineffective on a larger scale, or is the Cyclone Nargis case study unique? Answering these questions requires further analysis into the policy approaches and the outcomes that transpired following each disaster.

6. Analysis

The case studies addressed in the previous sections are valuable as they are generalizable with respect to the approaches that are present in the disaster management operations, yet they both highlight the significance of effective governance and the consequences of mismanagement. As discussed earlier, the goal of this paper is not to criticize nor praise the response efforts in specific countries but rather identify mechanisms for success and failure in disaster mitigation. However, in examining both case studies it is evident that both the preparation and response at the national level in Myanmar was lacking greatly which resulted in significant devastation and a remarkably high death toll. Although the SPDC contained a division of disaster management, there was little focus on risk reduction at the national level which resulted in insufficient preparation at the community level, especially those communities considered high risk along the delta. In contrast, populations in Bangladesh considered to possess a similar degree of vulnerability to tropical cyclones were seemingly better prepared having been engaged in risk reduction strategies provided by local governments in the upazila districts. It appears that not only did both countries have completely different approaches to managing the impacts of the respective cyclones, but the outcomes were also quite different, despite both cyclones being similar in intensity. The purpose of this section is to further analyze the impacts of both disasters using the analytical criteria, so that the findings can be discussed more broadly in the subsequent discussion section.

Bangladesh's Approach

While the effects of the Cyclone Sidr had major implications for the affected populations, the disaster mortality tells a somewhat different story. In comparison to other major cyclones that struck Bangladesh, of which were similar in terms of intensity, the death toll, which was estimated at roughly 3,400 lives lost, is significantly lower than that of previous disaster events that affected the country (Haque et al., 2015). The statistics here indicate that the preparation efforts displayed in Bangladesh prior to Cyclone Sidr played a role in mitigation. Furthermore, the relatively effective response also played a role in minimizing impact to the afflicted regions, further demonstrating the potential merits of a community-based approach. Despite the accomplishments, 3,000 lives lost is by no means an inconsequential number and as is the case with all disaster events, there are always lessons learned and opportunities to improve overall preparedness.

In addressing the analytical criteria, it is evident that actions taken place prior to Cyclone Sidr played a significant role in the minimization of potential negative outcomes. The assessment of risk and considerations of risk and vulnerability identification for communities was a crucial step in assisting such populations. The overall response phase was also generally effective as afflicted communities received aid following the disaster and the actions directly before and during the storm such as moving individuals to shelters and evacuation of coastal regions were relatively efficient. In examining the event complexity factor, it should be reiterated that Cyclone Sidr was a very intense disaster, so analysis of the previous factors must consider this point.

Additionally, Bangladesh's preparation included national warning systems with the help of neighboring countries which helped combat the complexity of the storm by putting greater emphasis on reducing uncertainties. In other words, the effort to maintain ahead of the storm in terms of preparation for all levels of society (both at the national and local levels), the Bangladesh case study indicates that event complexity can be dealt with to a degree if the proper mechanisms are in place.

The fundamental component of the bottom-up approaches in disaster management, or the CBDM framework more specifically, is the idea of promoting public participation and engaging communities at the local level in addressing their own areas of concern with respect to threat of disasters (Azad et al., 2019). However, Bangladesh's community-based approach addressed other aspects of disaster management such as the factors for consideration brought up earlier. The efforts put into developing risk reduction strategies based on the assessment of risk and the relatively effective response operations were significant factors in not only adaptation to climate-related disasters that will only become more intense in the future, but also in the inhibition of detrimental outcomes for the people of Bangladesh. Unfortunately, there were still considerable flaws in Bangladesh's implementation of the community-based approach which will be reviewed in the discussion section along with the consideration of the advantages and disadvantages of the bottom-up approach that was exhibited in Bangladesh.

Myanmar's approach

The Cyclone Nargis case study introduced a very different approach to disaster management and displayed the unique focus of the national government in Myanmar. The glaring lack of preparation displayed in Myanmar at the national level greatly increased the vulnerability of communities, specifically those in the coastal regions. Although the SPDC had a level of disaster management planning and procedures in place for tropical cyclones, the desire to maintain sovereignty seemingly interfered with the establishment of extensive mitigation strategies. It can be argued that by focusing on a centralized policy approach, Myanmar only exacerbated the issue as the top-down approach exhibited by the regime excluded populations from taking part in risk reduction schemes that would have been beneficial, as was the case in Bangladesh. By putting greater emphasis on state security rather than on the security of civilians, the response can be considered a massive failure and the statistics following Cyclone Nargis help to illustrate this. Not only was preparation prior to the storm lacking, but the response was even worse, as limited assistance was available due to the SPDC's inability to accept foreign intervention. The discernible failures in disaster management displayed in Myanmar indicate that there is not only room for improvement for the nation regarding assessing the threat of tropical cyclones going forward but the case study offers findings that can help determine factors that must be looked into in the future.

A major component of the Cyclone Nargis case study is the mismanagement of disaster operations at the national level, a complication that is not unique to Myanmar. Many countries still experience instability similar to what exists in the nation and based on the findings in this paper, this can be a significant obstacle for countries looking to

mitigate the effects of climate change. While addressing this issue on a large scale is impractical, this factor is worth examining in greater detail and should be considered in disaster management literature going forward as it can play a major role in preventing states from effectively minimizing risk as well as responding efficiently following a disaster. This recommendation is also associated with the concerns regarding the centralized governance in disaster mitigation as these approaches to managing disaster-based risk can introduce corruption at the top, as was the case in Myanmar. However, corruption does not solely exist in top-down approaches as there are issues with community-based approaches; for example, poor collaboration between local governments and NGOs seen in Bangladesh. As a result, mismanagement cannot be addressed through disaster management yet it must be recognized as a contributing factor to the failures of certain countries to successfully deal with the threat of natural disasters. Mismanagement therefore, should be considered an important factor in disaster management sector, yet its relation to the debate on top-down vs. bottom-up approaches remains uncertain.

A major aspect of the mismanagement of the effects of Cyclone Nargis in Myanmar was a direct result of the characteristics of the regime. As discussed in earlier sections, there was considerable corruption at the national level prior to the disaster which drastically increased the vulnerability of an already exposed country. The authoritarian rule of the military junta posed an immense threat to the security of local populations as there was very little preparation and implementation of risk reduction strategies into disaster mitigation policy. A major reason for the limited communication

came directly from the fear of invasion that troubled the nation historically, a factor that put local populations at immense risk. The top-down system exhibited in Myanmar clearly failed, however many of the shortcomings came as a direct result of the peculiarity of the regime. Therefore, this study cannot conclude that not all top-down approaches can be deemed ineffective as the Myanmar case study is rather unique, but rather the findings imply that we should be more critical of top-down approaches in disaster management as they open up a greater potential for authoritarian rule which not only inhibits growth in disaster mitigation but can result in additional environmental tragedies in the future, similar to what occurred in Myanmar. This is not to say top-down approaches to disaster adaptation should be removed completely, but with the possibility of introducing additional case studies such as what was experienced in Myanmar in 2008, there is clearly a level of concern going forward with this form of approach.

With respect to the analytical criteria developed in this study, the Myanmar case study proved to be unique in terms of the attempt to address the factors for consideration. As identified, the risk assessment factor was seemingly not present in the top-down approach and the case study as a whole which indicates a severe lack of preparation and planning in the pre-disaster phase. As a result, many communities had little or no protection from the storm from an infrastructural perspective which is one of the many reasons why the failure to address this factor was significant. The response at the national level through the SPDC's domain was extremely ineffective based on the efforts to essentially avert the impact of Cyclone Nargis. As a result, many communities, which were already quite vulnerable to this type of disaster, experienced further losses which

could have largely affected community resilience following the event. Regarding event complexity, this factor was a main feature in this case study which will require further discussion in the next section. In its integration with the Cyclone Nargis case, this factor almost acts as contradictory in that we truly cannot answer the question of whether or not the disaster was too intense because, as demonstrated throughout the case study, there were minimal efforts to actually devote attention to the disaster in all aspects. Further points on this idea will be discussed going forward.

Based on the outcomes observed following both Cyclone Sidr and Cyclone Nargis, the preparation and response from the Government of Bangladesh was much more effective. In adopting components of the Community-Based Disaster Management framework, the national government ensured that communities at the local level would be equipped to endure a catastrophic cyclone through risk reduction strategies. The quintessential element of the preparation for Cyclone Sidr was the motivation to empower vulnerable communities by encouraging participation in disaster risk assessment and reduction techniques. In appointing local governments to take action in assessing vulnerabilities and working to reduce the risk to tropical cyclones similar to those that struck Bangladesh in the past, communities were prepared for an intense disaster event and this became apparent as Cyclone Sidr approached.

7. Discussion

Key Findings

In examining the outcomes of both Cyclone Sidr in Bangladesh and Cyclone Nargis in Myanmar, it becomes apparent that several factors can contribute to the overall devastation following a natural disaster. The majority of these factors can be mitigated to an extent which is significant considering the difference large scale risk reduction strategies can make when they are implemented into a nation's disaster management planning. The factors that were initially analyzed in this study were risk assessment and identification of vulnerabilities, response efficacy, and event complexity. The analysis of the first factor, risk assessment, produced interesting outcomes as there were clear discrepancies in the identification of risk and vulnerability for communities in Bangladesh and Myanmar. The populations in both Bangladesh and Myanmar were unique as was anticipated, and therefore they have their own needs and unique requirements which complicated the analysis process. In analyzing the preparation and response in both countries, it became clear that Bangladesh's incorporation of the CBDM framework accounted for the identification of risk both geographically for coastal regions but also from a social perspective, while Myanmar's preparation lacked any true adoption of these techniques.

The effectiveness of response strategies was also studied and the information from both case studies suggests that Bangladesh's implementation of community-based, bottom-up approaches was overall more effective during the response phase than what

was exhibited in Myanmar with the top-down approach. However, there are notable flaws with making this claim as Bangladesh's approach still resulted in major issues for certain communities as international collaboration resulted in a significant delay in the distribution of resources to afflicted regions. There were also concerns with corruption between NGOs and local governments in Bangladesh that possessed the authority to manage the distribution of aid and studies hinted at the idea that there were inequities present as certain communities received more attention than others with no valid reason to do so (Nadiruzzaman & Wrathall ,2015). Yet in comparison to the actions taken place in Myanmar with Cyclone Nargis, the effects are nearly incomparable as the military junta failed to even allow aid to be distributed to the affected regions. The failures seen in Myanmar were so significant that any forms of comparison are not very conclusive as this case study is extremely unique.

The event complexity factor was third and final criterion that was examined in both countries. One of the research questions that arose in this study was: *to what extent can a disaster be too intense to effectively manage?* Answering this question is nearly impossible, yet the case studies provided in this study do offer an indication that all disasters can be managed to an extent. The cyclones analyzed in this study were on the severe side, with both Cyclone Sidr and Cyclone Nargis peaking at category 4 level storms. Despite the severity though, the efforts in Bangladesh greatly minimized impact and the devastation was arguably better than expected given the intensity of the storm. As a result, the findings show that although it cannot be confirmed based on the

information provided here alone, the disaster complexity factor is relevant and has a place in disaster management discussions.

Outside of the main issues addressed in the previous section, there were additional findings that were not originally considered when initially conducting the study. One key finding in this study was the positive correlation between preparation efforts and effectiveness of response both domestically and internationally. Although there were some issues in the response efforts in Bangladesh, most notably the miscommunication with neighboring countries following Cyclone Sidr, the international procedures were relatively effective as the GOB permitted assistance from neighboring countries as well as international organizations, allowing for the distribution of aid to reach coastal regions that were greatly affected by the devastation in the wake of the storm. With the development of disaster planning and procedures prior to the storm at both the national and local levels, the recovery phase was relatively short and the outcomes following succeeding Cyclone Sidr were reduced. As a result, the idea of preparation before a severe disaster is crucial and can be a pivotal factor in maintaining civil security for vulnerable populations.

Additionally, this study further highlights the importance of risk reduction prior to a natural disaster event and the motivation to take action promptly rather than waiting for a disaster to strike. As discussed in earlier sections, the development of disaster management literature has transformed the underlying assumptions that were previously ubiquitous in that disasters were in no way avertible (Basher, 2008). While this point may hold some validity, the disaster management literature has aimed to shift away from

this assumption as recent disasters help support the argument that humanity can play a significant role in disaster mitigation, but steps must be taken early on (Basher, 2008). The case studies in this paper thus support this notion that early action and preparation efforts are critical in ensuring the safety of communities in the event of a natural disaster. Further, the shift towards risk reduction measures prior to a storm rather than the reliance on community resilience is a fundamental aspect of the community-based policy approach that was exhibited in Bangladesh, so the shift towards pre-disaster development and planning should be the focal point going forward.

The case studies in this study also show that lessons learned are very important for countries following a particular disaster event. Disasters such as the ones presented in this paper can be seen as opportunities to improve existing infrastructure and planning procedures despite the considerable devastation they leave behind. For example, although Bangladesh had already seemingly put notable emphasis on preparation and response prior to Cyclone Sidr, additional effort was put forth following the event. The expanding of the Disaster Management Bureau was a key example of the continued development of the nation's disaster mitigation system, with greater attention on the shortcomings seen post-disaster (Haque et al., 2012). Further, Bangladesh, alongside many other nations, continued to adhere to many of the recommendations in the HFA and Sendai Framework in the years following Cyclone Sidr, showing the consideration for both state and civil security heading, a critical aspect of disaster management (Haque et al., 2015). By putting priority on disaster management policy, Bangladesh has greatly

reduced the vulnerability of local populations that would otherwise have little capacity to manage the impacts of large scale storms such as tropical cyclones.

The persistence shown in Bangladesh demonstrates the idea that all nations should be actively engaged in disaster mitigation efforts regardless of vulnerability or economic status. That is, even countries that may not be particularly vulnerable relative to Bangladesh and Myanmar should at the very least develop a plan for addressing the threat of disasters. Further, economically dominant countries like the U.S. can still learn from the approaches in Bangladesh despite the discrepancy in economic systems. Yet, although the strategies implemented at the time of Cyclone Sidr proved to be relatively effective, Bangladesh still has major issues in its adaptation procedures, in particular, response at the local levels which does require a level of capital. The case studies in this paper help display the significance of these economic factors, indicating that much of the capacity to prepare for and respond to disasters is based on affluence. This point is important because the focus of this paper is developing countries which lack the fundamental resources to respond to natural disasters and the analysis is fixated on opportunities to manage natural disasters that do not require significant capital or services, so this finding somewhat contradicts the initial analytical criteria. However, despite the ambiguity here, the findings in this paper do suggest that developing nations have the ability to play a significant role in preventing disastrous outcomes, even in large scale events such as Cyclone Sidr and Cyclone Nargis. Although growing economically in recent years, Bangladesh did not have sufficient resources to effectively mitigate the cyclone, yet the impacts suggest that the CBDM approach was relatively effective despite

the limited capabilities of GOB and NGOs at the local level. Future studies should look further into the economic factors discussed in this section, specifically the distribution of resources and aid within a given nation and how it relates to disaster preparation.

This paper also analyzed two common approaches that nations adopt in managing the risk to natural disasters for local populations. In the Myanmar case study, there is a clear top-down form of governance with respect to disaster management and the regime essentially dictated the mechanisms for response based on a centralized governing body in the SPDC. The Bangladesh case study arguably contradicted the approach seen in Myanmar as the government of Bangladesh allowed for a decentralized distribution of authority in adopting a community-based approach, empowering vulnerable communities and allowing them to get involved in an effort to reduce risk for all citizens. The analysis in this study implies that the CBDM framework is more effective than the top-down approach identified in Myanmar for a variety of reasons. Community-based approaches have been favorable among scholars in recent years with respect to disaster mitigation and international policies such as the Sendai Framework have also called for engagement risk-reduction strategies at the local level with the goal of reducing disaster-based mortality as well as the number of people affected by disasters going forward (UNDRR, 2007). Considering the information presented in this study combined with the overarching agreement from researchers in the field, community-based approaches should be the focal point for nations looking to effectively manage the impacts of large scale natural disasters.

While the bottom-up approach exhibited in Bangladesh deserves considerable recognition, it is important to note that there were still faults in the system. Some studies found that by putting additional resources into local level governance and relevant infrastructure, some of the resources were misused or misallocated. For example, some of the cyclone shelters in communities were still lacking the necessary foundations to withstand the intensity of a storm surge such as that seen in Cyclone Sidr, as a fraction of the death toll came from individuals in weak cyclone shelters (Karim & Mimura, 2008). Others critiqued the recovery phase as following Cyclone Sidr, some communities did not receive direct assistance as certain NGOs either lacked the communication and training necessary to perform their duties or intentionally corrupted the response efforts (Nadiruzzaman & Wrathall, 2015). These findings should not be ignored, and despite the success of the GOB and the communities in Bangladesh, more work is required. The concerns here indicate that while the CBDM framework may appear to be more effective than the existing hierarchical structures in nations like Myanmar, execution is still a major component. Putting greater emphasis on risk reduction at the community level and focusing on community-engagement are both great steps, but governments must ensure that resources are being allocated properly and defensive infrastructure will protect vulnerable populations. Based on this finding, more research is required in the bottom-up approaches discussed in this paper, specifically the methods for resource distribution between national governments and local level communities or organizations.

While the arguments in this paper may seem solely fixated on the analysis of both Bangladesh and Myanmar specifically, the examination of the policy approaches in each

country can be applied on a larger scale. The goal of this study was to determine how different nations with similar characteristics manage the impacts of natural disasters as well as to uncover what methods and procedures are effective and should be implemented going forward. However, the analysis section indicates that the two approaches highlighted essentially contradict each other fundamentally; the top-down approach seen in Myanmar with the authoritarian regime and the community-based approaches in Bangladesh display two contrasting means of governing the threat of natural disasters. In the previous section, the CBDM framework was praised and based on the outcomes observed in both case studies, community-based approaches to managing disasters presumed to be the better option for nations going forward. However, it is worth noting that all countries possess their own unique challenges and potential barriers that would impede the successful implementation of CBDM policies as outlined in the literature reviews section. As a result, it is important to note that any conclusions made in regards to which method is more effective may not entirely be applicable to all nations or regions for that matter. At the same time, the arguments made here should not solely pertain to Southeast Asia or the countries in this study for that matter, but on a larger scale. Furthermore, the policy approaches may also be applicable beyond disaster management, and thus should be analyzed in greater detail in other fields as well.

The debate consisting of policy approaches and forms of governance displayed in this study comes up rather frequently in public policy. Many global issues outside of disaster management require effective governance and many problems arise which call for proper administration. As a result, the conflicting approaches of top-down vs bottom-

up approaches should be considered when examining a variety of large scale problems that involve state and civil security. Climate change and climate policy in general work well here, as there is often disagreement regarding the distribution of authority and who should be held responsible for climate adaptation and mitigation within a country; many call for a local level (bottom-up) approach to managing impacts while others claim that authority should come from single entities with the majority of control. The issue of domestic vs international policy further complicates this issue as, for the example of climate change, climatic effects are transboundary, whereas natural disasters generally strike a single region or nation.

As of right now, there is no direct answer to these issues and with the additional information required in the field, these issues cannot be resolved at the moment. However, the basis of this paper could act as a theoretical framework for endeavors in other fields related to environmental policy. Although this paper examined tropical cyclones specifically, other studies could look further into the conflicting approaches in different context, which would help provide clarity in either verifying or negating the findings here. There are also broader connections within the climate studies discipline where the adaptation strategies identified in this paper could potentially be applied to other climate concerns. For example, if we take away the natural disaster component, strategies that solely focus on sea level rise could benefit from the framework described in this paper. It is also worth noting that future studies within the disaster management field should all consider the top-down and bottom-up approaches to governance in preparation for natural disasters as these approaches tend to be fairly common and can

play a major role in the severity of disaster-related impacts. Additionally, future studies could use the same or similar analytical criteria used in this study and explore different regions.

8. Conclusion

Given the general consensus among the scientific community regarding the intensity of tropical cyclones going forward, natural disaster management at both the national and local levels will be critical. As is the case with various aspects of climate change, adaptation and mitigation strategies are required immediately, especially for countries considered to be particularly vulnerable to specific disasters. While we cannot simply prevent such tragedies from occurring, humanity can play an active role in reducing risk for all populations, but especially those that are deemed particularly vulnerable. Natural disasters will continue to affect populated regions and unfortunately many will continue to lose their lives or be greatly impacted by the effects of such events, but as indicated in this paper, mitigation efforts can play a major role in reducing the devastation, and most importantly, saving lives. It is for this reason that disaster management remains a vital field and additional research is required to fully determine the effectiveness of disaster-based approaches that are prevalent in society.

References

- Ahamed, M. (2013). Community based approach for reducing vulnerability to natural hazards (cyclone, storm surges) in coastal belt of Bangladesh. *Procedia Environmental Sciences*, 17, 361-371.
- Alam, E., & Dominey-Howes, D. (2015). A new catalogue of tropical cyclones of the northern Bay of Bengal and the distribution and effects of selected landfalling events in Bangladesh. *International Journal of Climatology*, 35(6), 801-835.
- Anthes, R. (Ed.). (2016). *Tropical cyclones: their evolution, structure and effects* (Vol. 19). Springer.
- Atkinson, C., & Curnin, S. (2020). Sharing responsibility in disaster management policy. *Progress in Disaster Science*, 7, 100122.
- Azad, M. A. K., Uddin, M. S., Zaman, S., & Ashraf, M. A. (2019). Community-based Disaster Management and Its Salient Features: A Policy Approach to People-centred Risk Reduction in Bangladesh. *Asia-Pacific Journal of Rural Development*, 29(2), 135-160.
- Basher, R. (2008). Disaster impacts: Implications and policy responses. *Social Research*, 937-954.
- Bindoff, N. L., Willebrand, J., Artale, V., Cazenave, A., Gregory, J. M., Gulev, S., ... & Woodworth, P. (2007). Observations: oceanic climate change and sea level.
- Commonwealth Local Government Forum (CLGF). (2017). Bangladesh - CLGF. Retrieved October 27, 2020, from clgf.org/uk/default/assets/File/Country_profiles/Bangladesh.pdf
- Coskun, E., & Aubrecht, D. O. (2011, May). Complexity in emergency management and disaster response information systems (EMDRIS). In *ISCRAM*.
- Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., & Webb, J. (2008). A place-based model for understanding community resilience to natural disasters. *Global environmental change*, 18(4), 598-606.
- Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social vulnerability to environmental hazards. *Social science quarterly*, 84(2), 242-261.
- “GDP per Capita (Current US\$) - Bangladesh.” *Data*, data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=BD.

- Government of Bangladesh (GOB) (2008) Cyclone Sidr in Bangladesh: damage, loss and needs assessment for disaster recovery and reconstruction. Government of Bangladesh, Dhaka
- Gierlach, E., Belsher, B. E., & Beutler, L. E. (2010). Cross-cultural differences in risk perceptions of disasters. *Risk Analysis: An International Journal*, 30(10), 1539-1549.
- Fritz, H. M., Blount, C. D., Thwin, S., Thu, M. K., & Chan, N. (2009). Cyclone Nargis storm surge in Myanmar. *Nature Geoscience*, 2(7), 448-449.
- Haque, C. E., Khan, M. R., Uddin, M. S., & Chowdhury, S. R. (2015). Disaster management and public policies in Bangladesh: Institutional partnerships in cyclone hazards mitigation and response. *Disaster Risk and Vulnerability: Mitigation through Mobilizing Communities and Partnerships*; Haque, CE, Etkin, D., Eds, 154-182.
- Haque, U., Hashizume, M., Kolivras, K. N., Overgaard, H. J., Das, B., & Yamamoto, T. (2012). Reduced death rates from cyclones in Bangladesh: what more needs to be done?. *Bulletin of the World Health Organization*, 90, 150-156.
- Hossain, M. Z., Islam, M. T., Sakai, T., & Ishida, M. (2008). Impact of tropical cyclones on rural infrastructures in Bangladesh. *Agricultural Engineering International: CIGR Journal*.
- International Monetary Fund. (2019) World Economic Outlook Database April 2019."www.imf.org/external/pubs/ft/weo/2019/01/weodata/weorept.aspx?pr.x=63 .
- IPCC, 2018: Summary for Policymakers. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. *World Meteorological Organization, Geneva, Switzerland, 32 pp.*
- Islam, A. S., Bala, S. K., Hussain, M. A., Hossain, M. A., & Rahman, M. M. (2011). Performance of coastal structures during Cyclone Sidr. *Natural Hazards Review*, 12(3), 111-116.
- Nadiruzzaman, M., & Wrathall, D. (2015). Participatory exclusion-cyclone Sidr and its aftermath." *Geoforum*, 64, pp.196-204.

- Kapucu, N. (2011). Collaborative governance in international disasters: Nargis cyclone in Myanmar and Sichuan earthquake in China cases. *International Journal of Emergency Management*, 8(1), 1-25.
- Karim, M. F., & Mimura, N. (2008). Impacts of climate change and sea-level rise on cyclonic storm surge floods in Bangladesh. *Global environmental change*, 18(3), 490-500.
- Khan, M. R., & Rahman, M. A. (2007). Partnership approach to disaster management in Bangladesh: a critical policy assessment. *Natural Hazards*, 41(2), 359-378.
- Knutson, T., Camargo, S. J., Chan, J. C., Emanuel, K., Ho, C. H., Kossin, J., ... & Wu, L. (2020). Tropical cyclones and climate change assessment: Part II: Projected response to anthropogenic warming. *Bulletin of the American Meteorological Society*, 101(3), E303-E322.
- Lewis, D. (2011). *Bangladesh: politics, economy and civil society*. Cambridge University Press.
- Mahmud, S., & Barbier, E. B. (2016). Are private defensive expenditures against storm damages affected by public programs and natural barriers? Evidence from the coastal areas of Bangladesh. *Environment and Development Economics*, 21(6), 767.
- NASA. *Hurricane Season 2008: Tropical Storm Nargis (Indian Ocean)*. April 30, 2008. Accessed on March 22, 2021.
https://www.nasa.gov/mission_pages/hurricanes/archives/2008/h2008_nargis.html
- Naz, F., Doneys, P., & Saqib, S. E. (2018). Adaptation strategies to floods: A gender-based analysis of the farming-dependent char community in the Padma floodplain, Bangladesh. *International Journal of Disaster Risk Reduction*, 28, 519-530.
- O'Brien, G., O'keefe, P., Rose, J., & Wisner, B. (2006). Climate change and disaster management. *Disasters*, 30(1), 64-80.
- Paul, B. K. (2009). Why relatively fewer people died? The case of Bangladesh's Cyclone Sidr." *Natural Hazards* 50, no. 2 (2009): 289-304.
- Roberts, C. (2014). Myanmar, Cyclone Nargis and regional intermediaries. *Disaster Relief in the Asia Pacific: Agency and Resilience*, (44), 86.
- Sattar, M. A., & Cheung, K. K. (2019). Tropical cyclone risk perception and risk reduction analysis for coastal Bangladesh: Household and expert perspectives. *International Journal of Disaster Risk Reduction*, 41, 101283.

- Scolobig, A., Prior, T., Schröter, D., Jörin, J., & Patt, A. (2015). Towards people-centred approaches for effective disaster risk management: Balancing rhetoric with reality. *International Journal of Disaster Risk Reduction*, 12, 202-212.
- Seekins, D. M. (2009). Myanmar in 2008: Hardship, compounded. *Asian Survey*, 49(1), 166-173.
- Seekins, D. (2009). State, society and natural disaster: cyclone Nargis in Myanmar (Burma). *Asian Journal of Social Science*, 37(5), 717-737.
- Selth, A. (2008). Even paranoids have enemies: Cyclone Nargis and Myanmar's fears of invasion. *Contemporary Southeast Asia: A Journal of International and Strategic Affairs*, 30(3), 379-402.
- Shikada, M., Myint, U. T., Gi, K. K., Nakagawa, Y., & Shaw, R. (2012). Reaching the unreachable: Myanmar experiences of community based disaster risk reduction, in community based disaster risk reduction.
- Sze, J., & London, J. K. (2008). Environmental justice at the crossroads. *Sociology Compass*, 2(4), 1331-1354.
- Uddin, M. S., Haque, C. E., & Walker, D. (2020). Community resilience to cyclone and storm surge disasters: evidence from coastal communities of Bangladesh. *Journal of environmental management*, 264, 110457.
- United Nations Office For Disaster Risk Reduction (UNDRR). (2007). *Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters*. Hyogo: International Strategy for Disaster Reduction.
- United Nations Office For Disaster Risk Reduction (UNDRR). (2015). *Sendai Framework for Disaster Risk Reduction 2015-2030*. Sendai: United Nations.
- Wachinger, G., Renn, O., Begg, C., & Kuhlicke, C. (2013). The risk perception paradox—implications for governance and communication of natural hazards. *Risk analysis*, 33(6), 1049-1065.
- Walker, G., & Burningham, K. (2011). Flood risk, vulnerability and environmental justice: evidence and evaluation of inequality in a UK context. *Critical social policy*, 31(2), 216-240.
- Webster, P. J. (2008). Myanmar's deadly daffodil. *Nature Geoscience*, 1(8), 488-490.
- Zaw, T. N., & Lim, S. (2017). The military's role in disaster management and response during the 2015 Myanmar floods: A social network approach. *International journal of disaster risk reduction*, 25, 1-21.