

# Reinforcing Myanmar: Improving Disaster Resilience



An assessment of disaster resilience practice  
and resource management in Myanmar

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Hamish Kellam  
24 November, 2016

Cover Image: a villager crosses over to one of the many vulnerable rural communities still awaiting the rapid infrastructure development their urban counterparts have seen in the past decade (Rubin 2014).

# Table of Contents

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|  |        |
|--|--------|
| List of Figures and Tables .....                     | - 5 -  |
| List of Abbreviations .....                          | - 6 -  |
| <b>Executive Summary</b> .....                       | - 7 -  |
| Introduction.....                                    | - 8 -  |
| Methodology .....                                    | - 9 -  |
| <b>PART I: Resilience, in a World of Uncertainty</b> |        |
| 1.1 Introduction .....                               | - 10 - |
| 1.2 Managing Risk .....                              | - 10 - |
| 1.3 Resilience and Identity .....                    | - 11 - |
| 1.4 Self-Organising Systems .....                    | - 12 - |
| 1.5 Thresholds.....                                  | - 13 - |
| 1.6 Interconnectedness.....                          | - 13 - |
| 1.7 Adaptive Cycles .....                            | - 14 - |
| 1.8 Scales, Linkages, and Panarchy.....              | - 14 - |
| 1.9 Specific vs General Resilience .....             | - 15 - |
| 1.10 Five Forms of Capital .....                     | - 16 - |
| 1.11 Conclusion .....                                | - 17 - |
| <b>PART II: Myanmar, the Identity of the System</b>  |        |
| 2.1 Introduction .....                               | - 18 - |
| 2.2 Scales and Stakeholders .....                    | - 18 - |
| 2.3 People and Governance.....                       | - 21 - |
| 2.4 Values and Issues .....                          | - 22 - |
| 2.5 Disturbances .....                               | - 24 - |
| 2.6 Drivers and Trends.....                          | - 26 - |
| 2.6.1 Flooding .....                                 | - 26 - |
| 2.6.2 Cyclones and Storm Surges .....                | - 27 - |
| 2.6.3 Drought .....                                  | - 27 - |
| 2.6.4 Earthquakes .....                              | - 27 - |
| 2.6.5 Fires.....                                     | - 28 - |
| 2.6.7 Landslides .....                               | - 28 - |
| 2.7 Conclusion .....                                 | - 28 - |

## **PART III: Activities and Funding**

|  |        |
|--|--------|
| 3.1 Introduction .....                 | - 30 - |
| 3.2 Decentralising.....                | - 30 - |
| 3.3 Community Driven Development ..... | - 31 - |
| 3.4 Stakeholder Coordination .....     | - 33 - |
| 3.5 Natural Defence Conservation ..... | - 34 - |
| 3.6 Mainstreaming DRR .....            | - 35 - |
| 3.7 Conclusion .....                   | - 37 - |

## **Recommendations and Conclusion**

|                         |        |
|-------------------------|--------|
| Recommendations.....    | - 39 - |
| Conclusion .....        | - 39 - |
| <b>References</b> ..... | - 40 - |

## List of Figures and Tables

|   |      |
|---|------|
| Figure 1.1 – The risk relationship triangle .....                               | 11 - |
| Figure 1.2 – The self-organising system .....                                   | 12 - |
| Figure 1.3 – Different stable states of socio-ecological systems .....          | 13 - |
| Figure 1.4 – Adaptive cycle of self-organising systems .....                    | 14 - |
| Figure 1.5 – Overlapping nature of adaptive cycles .....                        | 15 - |
| Figure 2.1 – Map of states, regions, union territory and townships .....        | 19 - |
| Figure 2.2 – Organisational structure of the GAD in Myanmar .....               | 21 - |
| Figure 2.3 – Administrative hierarchy structure of Myanmar .....                | 22 - |
| Figure 2.4 – Myanmar internally displaced and flood affected peoples .....      | 26 - |
| Figure 2.5 – Dry zone map of Myanmar .....                                      | 27 - |
| Figure 2.6 – Natural hazard risk map of Myanmar .....                           | 29 - |
| Figure 3.1 – Summarising community-stakeholder development .....                | 31 - |
| Figure 3.2 – UNDP Human Development Initiative (HDI) summary .....              | 32 - |
| Figure 3.3 – Forest cover status of Myanmar 2007 .....                          | 34 - |
|   |      |
| Table 1.1 – Summary of keys to resilience thinking .....                        | 11 - |
| Table 2.1 – States, regions, and union territory by ecological region .....     | 18 - |
| Table 2.2 – Relevant stakeholders and their corresponding system of scale ..... | 20 - |
| Table 2.3 – Stock and flow subsectors within the Myanmar system .....           | 23 - |
| Table 2.4 – Ecological regions, hazards, seasonal impacts, and government ..... | 25 - |
| Table 3.1 – National priorities, frameworks, and government .....               | 33 - |
| Table 3.2 – Cost estimates for ‘building back better’ post-disaster .....       | 35 - |
| Table 3.3 – Potential economic gains of sustainable development .....           | 36 - |
| Table 3.4 – Delivery spending for UNDP CPAP .....                               | 36 - |

## List of Abbreviations

|        |  |
|--------|--|
| ADPC   | Asian Disaster Preparedness Center                                 |
| CPAP   | Country Programme Action Plan                                      |
| DoMH   | Department of Meteorology and Hydrology                            |
| DRR    | Disaster Risk Reduction  |
| GAD    | General Administration Department of Myanmar                       |
| GFDRR  | Global Facility for Disaster Reduction and Recovery                |
| HDI    | Human Development Index  |
| IGO    | Inter-Governmental Organisation                                    |
| IID    | Institute for International Development                            |
| MIMU   | Myanmar Information Management Unit                                |
| NGO    | Non-Government Organisation  |
| OCHA   | United Nations Office for the Coordination of Humanitarian Affairs |
| UNDP   | United Nations Development Programme                               |
| UNISDR | United Nations International Strategy for Disaster Reduction       |
| UNFPA  | United Nations Population Fund                                     |

## Executive Summary

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This report has been prepared in conjunction with the Institute for International Development (IID) and the University of Adelaide as part of the Arts Internship program. Its aim is to encourage institutional action and funding for Disaster Risk Reduction (DRR) activities to be mainstreamed into contemporary development practice, in hopes of creating more cost-effective and efficient initiatives. Discussion is centred around the country of Myanmar, where evaluation suggests that the pre-emptive implementation of DRR and land management policies yields successful results. The first section of the report provides an overview of the theory behind DRR and resilience practice. The context of Myanmar is then analysed while illustrating the suitability of such an approach. Finally, promising DRR activities in Myanmar are discussed along with their influence on development funding.

The study has had access to a range of experts and professionals in the field of development, yet it has ultimately been limited by the lack of reliable historical evidence and statistics stemming from Myanmar in the past half century. Being remotely based, the study has also been limited from having any direct interaction with community, government, and other stakeholders within Myanmar.

The following recommendations have been made to potential partner institutions:

- Promote diversity in decision-making and DRR programs
- Encourage community driven development programs in a similar tone to those driven by the United Nations Development Programme (UNDP) and World Bank
- Coordinate a range of relevant stakeholder activities through the General Administration Department (GAD) of Myanmar
- Continue to advance decentralised decision-making processes, progressing from the pivotal Township level of the GAD
- Aim to mainstream DRR into development practice in order to achieve investment cost-savings and efficiency
- Create close feedback and interconnected processes between communities and stakeholders to build on their joint capacities

The report draws attention to the fact that as climate change increasingly exacerbates the impact of both slow and fast moving disasters, pre-emptive DRR programs must be considered as, if not more, important as post-disaster relief planning. The study concludes that the direct and indirect capital benefits of preventative, DRR-centred development presents governments and institutions with a far more cost-efficient alternative than the conventional disaster relief measures of the past.

# Introduction

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Disasters caused by both natural hazards and human negligence are emerging as core factors in constraining international development. DRR has become a field of major importance in achieving development objectives and overcoming the increasingly damaging effects of disasters. Development patterns, particularly population growth in high-risk areas and environmental degradation, continue to be the most important drivers of disaster risk (Small-Lorenz et al. 2016). If we think of such communities as an immune system, we realise that without care and attending to, they will get sick and crumble. Yet as these patterns continue to emerge it is clear that building a culture of prevention is not an easy task. While the costs of prevention are paid in the present, the benefits lie in the distant future. Hence, most benefits are intangible; they are comprised of the disasters that did not happen (Annan 1999).

This research intends to explore the ways in which more disasters may be averted, particularly in the Republic of the Union of Myanmar (also known as Myanmar or Burma<sup>1</sup>). According to the Global Climate Risk Index, Myanmar was stricken by extreme weather events the second most of any country between 1995 and 2014 (Kreft et al. 2016). It was struck most notably by Cyclone Nargis in 2008, yet has continued to face the ongoing effects of slower moving, less publicised disasters all the while (Leake 2013). As 2016 heralded the first openly contested general elections in the country since 1990, hope and opportunity for reform in Myanmar is soaring (Ninh & Arnold 2016). Nonetheless, many existing initiatives are quickly running out of reserves from the aid community and will require reinforcement (UNDP 2015). Findings provided here lend support to the position that pre-emptive DRR actions are far more cost-efficient investments than traditional relief and recovery efforts. Even with the best intentions, these management strategies sometimes turn our precious ecosystems from valuable assets into expensive liabilities (Walker & Salt 2012). This report aims to address many of Myanmar's vulnerabilities and elevate the importance of natural hazards in the formulation of country lending programs and project lending for international institutions.

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<sup>1</sup> Name formally changed by the ruling military government from 'Burma' to 'Myanmar' in 1989. This change is recognised by the United Nations but not by a number of countries, including Australia and the USA. This paper will use the country's self-proclaimed 'Myanmar' label. This does not reflect any political standing.



## Methodology

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The report provided draws from a range of academic literature on DRR and land management strategies as a base, with many statistical references stemming from the Myanmar Information Management Unit (MIMU). Primary information has been utilised various from books and papers published by those with extensive experience in Myanmar. In particular, invaluable correspondence with a director of IID, John Leake, has served to assist in developing relevant recommendations for donor institutions. Emergency response servicemen were also consulted for advice on prioritising factors of resilience. Reliable secondary information coming out of Myanmar was often hard to come by due to its isolated past nature, yet many projects completed by institutions such as the UNDP and World Bank have provided crucial guidance for the direction of the research.

# PART I: Resilience, in a World of Uncertainty

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## 1.1 Introduction

Resilience thinking provides a systematic way of looking at the complexity, uncertainty and interconnection of systems and processes, and above all, provides new pathways for approaching the planning and more effective use of resources in DRR and development (Battencourt et al. 2013). Resilience thinking can be a source of inspiration for those who want to extend their thinking beyond the baseline interpretation of sustainability and development, but it also follows some of the challenging ideas underpinning the field of DRR. That is, the future is unpredictable; change is inevitable; and increasing stability leads to vulnerability (Slootweg & Jones 2011). Beyond this, merging resilience and DRR into mainstream development drastically improves economic effectiveness and ensures more lasting value for every dollar spent on projects.

## 1.2 Managing Risk

Risk management is a fundamental of DRR and is often expressed as a function of hazard and vulnerability. It is equivalent to what might be defined as the harmful ‘consequences’, or measured outcome, of hazard impact (Granger 2014). This may include casualties, injuries, lost livelihoods, damaged property, disrupted economic activity, and environmental damage, all resulting from interaction between hazards and vulnerable elements at risk (UNISDR 2004). Hazards refer to potentially damaging natural or human-induced phenomena, which may occur within a specific period of time in a particular vulnerable area. Vulnerability then relates to the degree of susceptibility or resilience of a community and environment to the occurrence of these hazards, often determined by influential physical, social, economic and environmental factors (UNISDR 2004). The risk relationship between these elements is often expressed as a formula:

$$\text{Risk}_{(\text{total})} = \text{Hazard} \times \text{Elements at risk} \times \text{Vulnerability}$$

This relationship has also been demonstrated in Figure 1, based on David Crichton’s (1999) own ‘risk triangle’. The total risk is represented by the area inside the triangle, with each side representing the level of exposure (of elements at risk), vulnerability, and hazard. As the size and nature of hazards themselves are difficult to predict, much less control, the majority of DRR is spent mitigating exposure and vulnerability components. Figure 1.1 illustrates this, in that a decrease in either of these factors will produce a smaller corresponding risk (shown by the smaller shaded triangle). If risky locations, such as flood plains, were avoided in development altogether, communities

would already lessen their exposure and in turn the total risk. Conversely, the extremity and frequency of precipitation due to climate change will increase exposure, and therefore increase the risk of disasters such as landslides and flooding (Small-Lorenz et al. 2016).

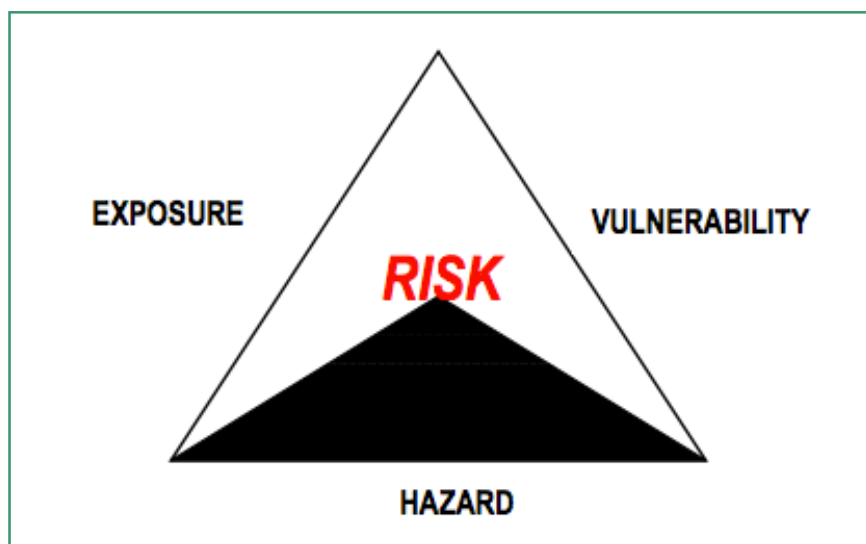


Figure 1.1: Crichton’s Risk Relationship triangle between risk, hazard, exposure and vulnerability (Chriton 1999).

### 1.3 Resilience and Identity

In its Hyogo Framework for Action 2005-2015, the United Nations International Strategy for Disaster Reduction (UNISDR) describes ‘resilience’ as:

“The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure” (UNISDR 2005).

The DRR perspective tends to focus on resilience in two ways: the speed of recovery post-shock, and the actual ability of a system to recover. The goal of this recovery is to return to a functioning structure after absorbing and overcoming a disturbance. This structure is incredibly important, and is known as a system’s *identity*.

Table 1.1: Summary of keys to resilience thinking

1. Systems are self-organising.
2. There are thresholds to the self-organisation capacity of a system.
3. Systems have interconnected social, economic, and ecological realms.
4. Self-organising systems pass through adaptive cycles.
5. Systems have cross-scale and dynamic interactions.
6. Differences exist between specified and general resilience.
7. Resilience involves both adapting and transforming.
8. Resilience comes at a cost.

Identity is a key concept of resilience thinking in that it reinforces the idea that while systems may adapt or vary in a number of ways as they deal with disturbances, they will always retain an overall identity and will not become something else entirely (Walker & Salt 2012). While there has traditionally been a focus on recovery as a sign of resilience, building an identity of endurance will allow a system to address shocks before they occur. Table 1.1 summarises the key aspects of resilience thinking, adapted from those proposed by Walker and Salt (2012). This first section of the report introduces some of these fundamentals before later applying them to the case of Myanmar.

## 1.4 Self-Organising Systems

Resilience thinking holds that all functioning systems in the world are complex and adaptive systems (Walker & Salt 2012). This concept holds whether applied to farms, to schools, human bodies, even governments. As parts of these systems are changed or affected, they will adapt and self-organise themselves around the disruption. These self-organising systems may sometimes be predictable, yet at other times have entirely unforeseeable results. These systems primarily enjoy a wide degree of elasticity and can endure most external disturbances; for instance, a river ecosystem managing varying degrees of fishing activity. The system is capable of absorbing the external disruption and reorganising itself to continue operation; hence, maintaining its identity. However, extreme events occur that are capable of pushing this elasticity too far, to a breaking point beyond self-organisation and recovery. Figure 1.2 demonstrates a simplified version of the self-organising system. The circle is the system's boundaries where the two arrows represent the flow of information and resources powering the system (Leake 2013). The system must be open at both ends to facilitate this flow, utilised for attaining resilience.

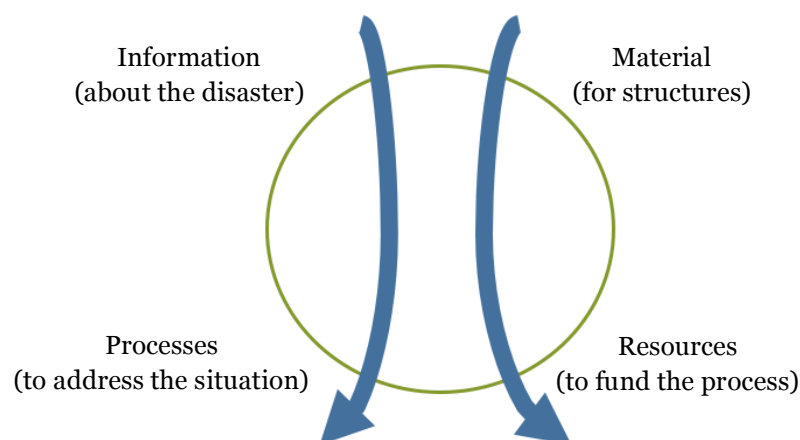


Figure 1.2: The self-organising system (based on Capra 1997).

## 1.5 Thresholds

This point beyond a system's self-organisation and recovery is known as a threshold. Once this limit is traversed the system will enter into a different condition, changing its identity. Systems tend to have one or more of these alternative states that are determined by multiple threshold values (Gunderson et al. 2016). Social-ecological systems are exposed to gradual variations in variables such as climate, resource fragmentation, and wildlife composition, and are able to adapt smoothly to these perturbations (Slootweg 2011). However, due to the non-linear nature of these systems, they are also able to cross suddenly into another state where coordinated impacts set in. Figure 1.2 demonstrates the alternate states of social-ecological systems, as opposed to conventional environmental management where predictable linear change is assumed (Walker & Salt 2012). In essence, DRR and management should be focused on facilitating these thresholds in order to keep a system in a desired state, and when the system does cross into undesired territory, to create ideal conditions that will transform it back into a more desirable state.

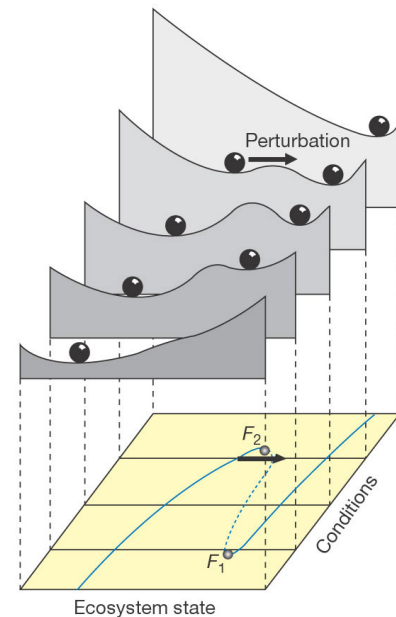


Figure 1.3: The different stable states of socio-ecological systems.

## 1.6 Interconnectedness

Many issues arise within DRR and resource management due to ignorance of the linkages between a system's various social, economic, and ecological spheres of influence. Deforestation may significantly exacerbate the impact of floods, but simple logging quotas and restrictions will not account for the economic issues of a logger. His choice to log illegally may provide extra food and money for his family in the short term, yet he might also be exposing them long-term risk of their home being eventually flooded. These social-ecological systems are composed of intertwined natural and human societies, with both reciprocating feedback and interdependence (Slootweg 2011). The separate components may be identifiable, but they are very difficult to separate in analysis and practice. Changes in one domain (such as debt levels in the economic) will often present changes in the other (such as deforestation in the ecological, or stress in social), cycling around to create more change in the first sphere. Crossing a threshold in one sphere may also lead to a threshold overstep in another, turning it into an undesirable system as a whole. The complexity of these self-

organising systems underlines the importance of understanding the connections and influence between fields.

## 1.7 Adaptive Cycles

Self-organising systems will change over time, often due to internal processes as opposed to external factors. These components interact within a system in a cyclical motion, an 'adaptive cycle', consisting of a 'fore loop' and 'back loop' (Gunderson & Holling 2002). The adaptive cycle has four phases: rapid growth (exploitation), conservation, release, and reorganisation. The fore loop is the development loop, which encourages forms of capital accumulation brought on by stability, relative predictability, and conservation (Figure 1.4). Conversely, the back loop is a collapsing loop where reorganisation occurs to provide capital for restorative growth.

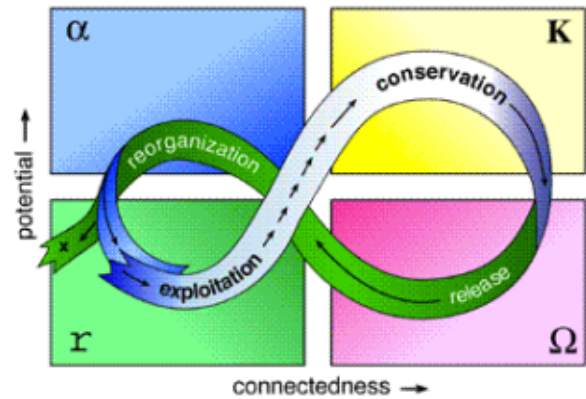


Figure 1.4: The adaptive cycle of self-organising systems (Gunderson & Holling 2002).

The fore-loop facilitates a slow moving change from the exploitation phase while the resources for growth are built up, into a conservation phase where resources are increasingly locked up within the system's structure. The back loop displays a swift collapsing phase occurring after a shock to the system, releasing resources and setting the scene for a time of either great destruction or creative change (system reconfiguration), before entering a period of newfound growth. If a system is resilient, it will reorganise to its original identity, whereas an un-resilient one may enter another state or descent into poverty, marked by the point 'x' in Figure 1.4. A successful sociological example of the adaptive cycle was the Myanmar 2015 General elections, which after decades of a slow-moving conservation stage, swiftly entered a release phase and was able to reorganise itself into a positive alternate state. This will be discussed further in Part II of this report.

## 1.8 Scales, Linkages, and Panarchy

The adaptive cycle is a useful tool for comprehending self-organising systems, but variations in these social-ecological systems does not always follow the smooth cyclical motion. Collapses may be organised at lower scales in order to avoid a more devastating collapse at a later, higher scale. This is the thinking behind the usefulness of decentralisation, which will be considered later. Self-organising systems operate

through a range of time and planes, all simultaneously partaking in their own adaptive cycle (Gunderson & Holling 2002). These scales are sometimes linked, so what happens in one cycle may drastically affect those of another scale. A President may be more focused on the national scale, but his decisions will greatly influence regional, township, and even personal scales. To fully comprehend one scale, all those linked to it must be evaluated and understood, as diagrammed in Figure 1.5.

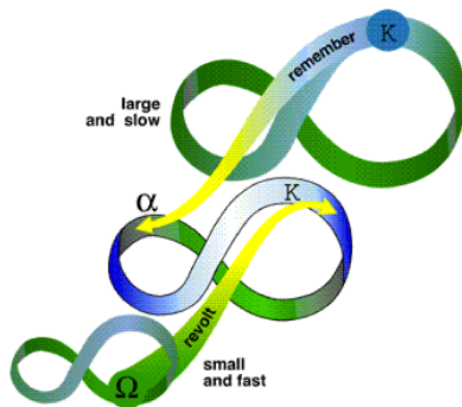


Figure 1.5: The overlapping nature of adaptive cycles (Holling 2004).

If a higher scale is going through a conservation phase, change is difficult for those below it, with the opposite being true when going through an active growing phase. Another issue facing DRR is the risk of synchronisation. When lower scale settings (for example, farms) have excess shared characteristics, they leave themselves in synch and vulnerable to the same hazards. By employing diversity in natural hazard prevention measures and locations, smaller individual release phases may be experienced, but the overall larger system will face a far lesser chance of collapse. Ignoring these cross-scale

effects can lead to enormous failures in disaster preparedness and resource management. This interwoven view of systems presents a more sustainable policy approach to the typical hierarchical approach of policy development, where decisions are made at a higher scale and descend down to the planning, program, and community levels (ADPC 2009). While some decision making is ultimately restricted by national and administrative borders, resilience thinking encourages different the usage of smaller scale management institutions in strategy formulation.

## 1.9 Specific vs General Resilience

The above sections draw a general blueprint of what makes up resilience as a concept. In any system, however, there will be two kinds of resilience: specific and general. Specific resilience is the resilience of a system to a particular shock or disturbance (Walker & Salt 2012). General resilience refers to a system's capacity to absorb a range of disturbances in order to keep all the pieces of a system working as intended. By controlling the state of a system or managing its thresholds, the specific resilience to a certain upset may be improved. However, by improving specific resilience capacities, the general resilience to other impacts on a system may be diminished. By improving structures to combat flooding, the resilience to earthquakes might then suffer. Diversity is an incredibly important characteristic found in systems with high levels of general resilience, as well as others such as diversity, openness, capital reserves,



feedback, modularity, and redundancy. On the other hand, rigid, efficiency-driven, top-down control and management strategies have low adaptive capacities and low levels of general resilience (Gunderson et al. 2016).

### 1.10 Five Forms of Capital

As Figure 1.2 demonstrated, self-organising systems require information, material, processes, and reserves (resources) in order to function. These factors exist in the form of capital, which presents itself in other forms than just financial (Goodwin 2003):

1. **Financial Capital** is capital in the form of money that can be invested in an activity which produces something – at the very least if it will produce more money. Local governments often take on a project like building a bridge before collecting the tolls that will pay for it. Financial capital allows productive activities such as this to get going in advance of the returns that will flow from them.
2. **Natural Capital** refers to natural resources, which may be classified as capital considering their role in ecologically productive processes. For example, the ability of a pool of water to support various kinds of animal and plant life is able to be considered part of a productive ecological system, where the economic system is, ultimately, a subset of the ecological system.
3. **Produced Capital** is defined as physical assets that result from applying human productive activities to natural capital. It is also thought of as the output providing a flow of goods or services.
4. **Human Capital** should be thought of as the stock of potential capabilities, which can yield a flow of services. In essence, labour. These capabilities depend not only on knowledge, education, training, and skills, but also include useful behavioural habits as well as levels of energy and physical and mental health.
5. **Social Capital** is the intertwined result of social networks and trust. Social networks are a potent source of resilience, and have emerged as being very valuable when a shock occurs, yet are difficult to measure numerically. They are both formal and informal networks that can act quickly and effectively when needed, and are not active all the time so therefore have no maintenance costs (but can be quickly utilised without the normal period of trust building required for a network to operate) (Goodwin 2003).



## 1.11 Conclusion

A key thought to remember in resilience concepts is that resilience is neither good, nor bad. The adaptive cycle discussed is aimed, ideally, to return a resilient system to its previous state. This state, however, may be in any kind of position. Some dictatorships have been found to be highly resilient, as is a barren desert. Actors within DRR must choose whether to maintain a system's identity by adapting (if the pre-existing state is desirable), or whether to transform the system's identity into one of enhanced capabilities for its situation. Which road to travel will be determined by a system's preparedness for change, options for change, and its capacity to change.

## PART II: Myanmar, the Identity of the System

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### 2.1 Introduction

Walker and Salt (2012) note that there is a minimum, yet sufficient level of information required in order to make strong, effective decisions in disaster planning and management. Resilience practice is not about knowing everything, but attaining this *requisite simplicity* (Walker & Salt 2012). Self-organising systems, especially those as diverse as a country like Myanmar, are incredibly complex, unpredictable, and uncontrollable. Hence, this section of the research has aimed to attain an effective requisite simplicity so that analysis and ongoing solutions might be pursued.

### 2.2 Scales and Stakeholders

Myanmar is the second largest country in Southeast Asia and hosts a diverse range of landscapes that span its 676,578 square kilometres of territory (CIA 2016). The latest census in 2014 puts the population of Myanmar at an estimated 51.5 million people (Department of Population 2015). Administratively, Myanmar is split into seven states, seven regions and one union territory. Figure 2.1 on the following page shows these numerous administrative boundaries, also demonstrating the layout of these boundaries into the following three ecological regions, classifications that serve as useful indicators of where to expect particular natural hazards to occur:

|  |  |
|--|--|
| <i>Fertile Delta &amp; Coastal regions</i> | Ayeyarwady, Bago, Kayin, Mon, Rakhine, Tanintharyi, Yangon |
| <i>Central plains</i>                      | Magway, Mandalay, Nay Pyi Taw, Sagaing                     |
| <i>Northern mountainous regions</i>        | Chin, Kachin, Kayah, Shan                                  |

Table 2.1: List of administrative states, regions, and union territory by ecological region (ADPC 2015).

# Myanmar States/Regions and Townships

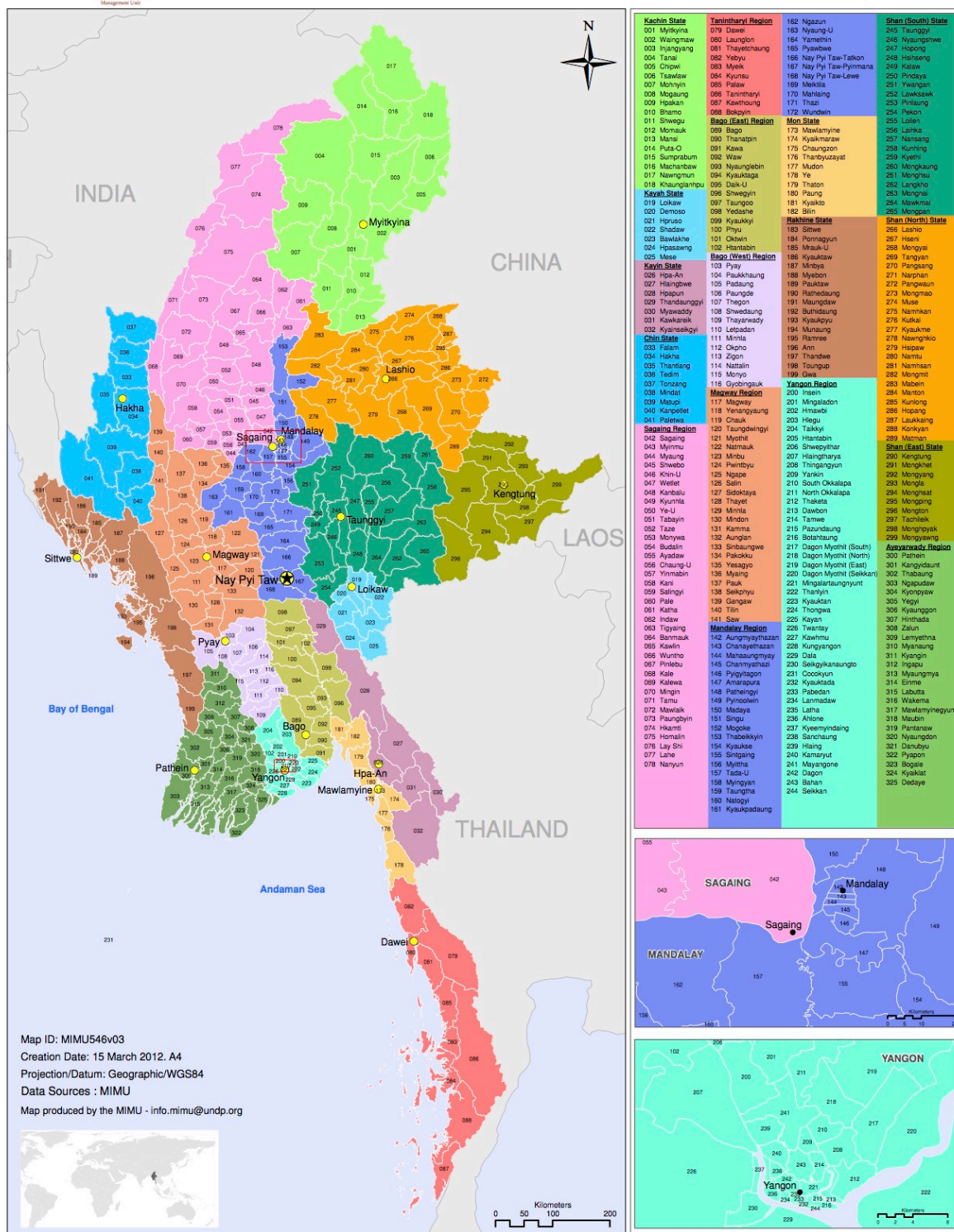


Figure 2.1: Map of the administrative states, regions, union territory and townships (MIMU 2016).

While these ecological and smaller focal scales will be discussed in the report, there are stakeholders at other scales that must be considered both directly and indirectly in decision-making due to their interconnectedness (Table 2.2). That said, the recommended focal scale of this report is at the Township level of government. At this level, the decision-making process stays on a personal level; the small number of governing representatives know each other, and they are familiar with their particular landscape and the communities that inhabit them. Moving to a higher scale than this leaves a space of disconnect between those in power and the people who their decisions most impact (Ninh & Arnold 2016). In the opposite direction, taking a lower focal point of assessment will mean that decision-making does not influence enough people, possibly only those in a small community or village. The Township scale is also able to maintain trust between other connecting scales, something incredibly vital to effective policymaking.

| <b>Scale</b>                          | <b>Stakeholders</b>   |
|---------------------------------------|---|
| <i>Largest (International) System</i> | Sovereign governments, IGOs, NGOs, corporations, religious networks   |
| <i>Large (National) System</i>        | Central government, Tatmadaw, Hluttaws (national and regional), ministries, departments, councils, NGOs, traditional leaders, religious networks, State services, administrative subdivisions (states, regions, union territory, self-administered zones and divisions) |
| <i>Focal Township Scale System</i>    | Township administrator, districts, local committees, national stakeholders  |
| <i>Smaller Scale Systems</i>          | Village tracts, village tract administrators, wards, villages, general population, along with national stakeholders, emergency responders   |

Table 2.2: List of relevant stakeholders and their corresponding system of scale (Cosgrove 2007).

The focal apparatus, on the other hand, is the General Administration Department (GAD). The GAD is central to the functioning of administrative mechanisms across the country. No other government organization has such a wide presence in the country, as even the Tatmadaw (the armed forces) are less spread among the general population to the same degree (Chit Saw & Arnold 2016). The GAD's primary function is the management of the country's public administrative structures, both hierarchically and geographically. The importance of the GAD, however, depends not so much on what it explicitly controls (which is in fact a large amount), but more so because of the GAD's ubiquitous presence, and its authority to coordinate, communicate among, and convene other government actors (Chit Saw & Arnold 2016).

The GAD is unique in that it supports coordination and communication among Myanmar's 36 ministries, and connects the capital to an estimated 16,700 wards and village tracts (Chit Saw & Arnold 2016). The diagram in Figure 2.2 illustrates the reach of the GAD (which is part of the Ministry of Home Affairs (MoHA)). By organising from the Township level of GAD, development projects will have access to roles ranging from tax collection, land management, and various registrations and certifications (Chit Saw & Arnold 2016).

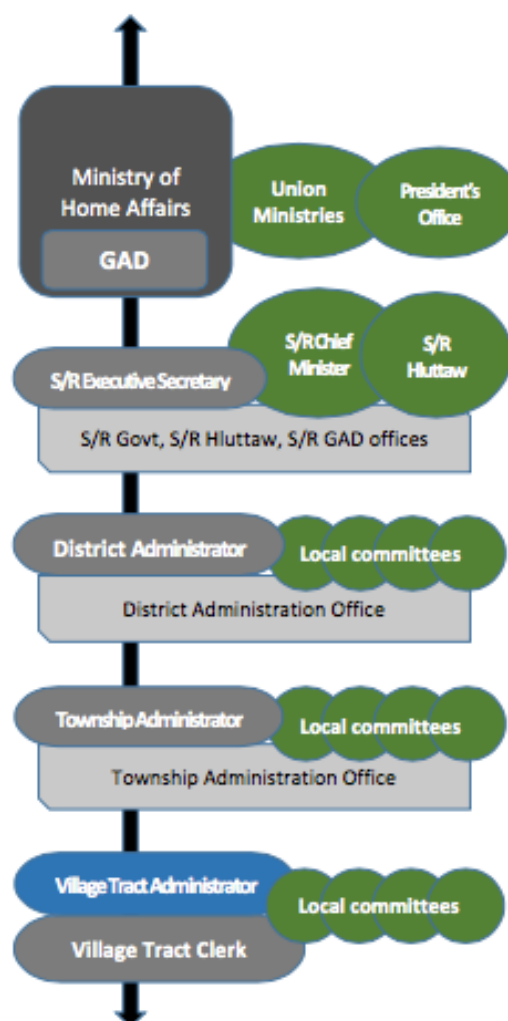


Figure 2.2: Organisational structure of the GAD in Myanmar (Chit Saw & Arnold 2016).

## 2.3 People and Governance

Myanmar is administratively split into multiple territories that follow a general hierarchical structure (Figure 2.3). The administrative capital of Myanmar was moved to Nay Pyi Taw in 2008, but much of the Central Government's and country's activities are still based out of Yangon City (Leake 2013). The Central Government and its institutions have a strong representation in the 74 Districts as well as all of the subdivided Townships (MIMU 2016). Even in the smaller system village tracts, appointed village headmen (*thu gyi*), bureaus, and local service centres extend government influence and services. The Tatmadaw also maintain a large presence throughout the country and its subdivisions (Leake 2013).

There are three levels of local government in Myanmar: township councils, town or wards, and village committees. These levels all operate in conjunction with religious institutions, retired service personnel, and additional associations (Mercy Corps 2014). Village headmen are appointed by the government, with some occupying the additional role of traditional leader. This mix between communities, associations, and government increases the social capital of regions within Myanmar and sets the



foundation for active resilience (Leake 2013). With the first openly-contested democratic elections since 1990 taking place in 2015, there is renewed hope for effective change in governance and policy (Rieffel & Fox 2013).

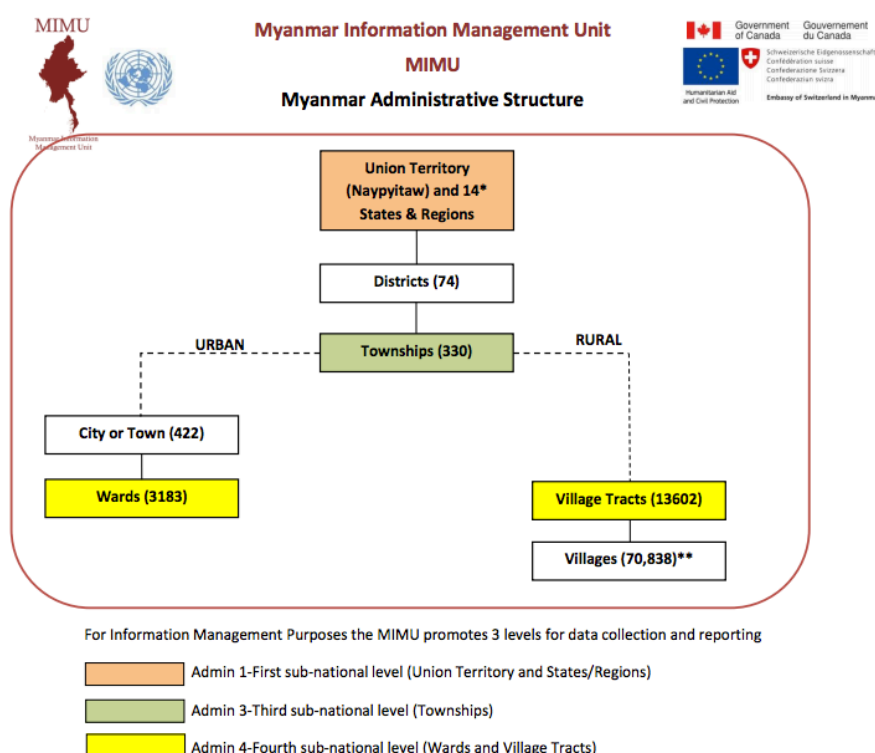


Figure 2.3: Administrative hierarchy structure of Myanmar (MIMU 2016).

\*Note: according to the 2008 Constitution, there are total 7 States, 7 Regions and 1 union territory, however in the MIMU P-Code list; Shan States is subdivided into 3 Sub-States (South, North and East); Bago Region is subdivided into 2 sub-regions (East and West). There are also 6 Self-Administered Zones/Divisions which include 18 of the 330 townships across the country.

## 2.4 Values and Issues

The Myanmar system is made up of two component categories. The first are flows, which are things produced by the system, such as farm produce, livestock, timber. The second are stocks, which are the factors within the system that produce flows (Markandya & Pedroso-Galinato 2009). Stocks are comprised of raw reserves such as soil, water, and financial capital. Stocks are the source of ‘wealth’ in a system that allow it to be self-organising and operational (refer back to Figure 1.2). There is often a trade-off interaction between flows as stocks are used in different ways. By identifying and managing stocks and flows, we can determine the underpinning causes of fluctuation in Myanmar’s natural defences against disasters. Table 2.3 displays the various sectors and subsectors from which stocks are found and flows result from in Myanmar.

Relevant stakeholders from the Asian Disaster Preparedness Center report (2015) have indicated the need for proper disaster risk assessment in these areas.

| Sector                               | Subsector                                   |
|--------------------------------------|---|
| Agriculture                          | Agriculture                                 |
|                                      | Fisheries                                   |
|                                      | Livestock                                   |
| Communication                        | Digital Infrastructure                      |
|                                      | Telecommunication                           |
|                                      | Mass media                                  |
| Education                            | Education                                   |
|                                      | Education infrastructure                    |
|                                      | Teacher training                            |
|                                      | Curriculum development                      |
| Environment                          | Land and Water                              |
|                                      | Marine environment                          |
|                                      | Ecosystem services for DRR                  |
| Finance and Economy                  | National and local planning                 |
|                                      | Fiscal management                           |
|                                      | Equity and eradicating poverty              |
| Health                               | Child Health                                |
|                                      | Public Health                               |
|                                      | Health infrastructure                       |
| Urban development and infrastructure | Housing and urban land use                  |
|                                      | Public assets                               |
|                                      | Critical facilities                         |
|                                      | Energy                                      |
| Rural development                    | Rural infrastructure                        |
|                                      | Rural housing                               |
|                                      | Water and sanitation                        |
|                                      | Land use                                    |
|                                      | Livelihood                                  |
| Social                               | Social protection                           |
|                                      | Enabling disadvantaged groups               |
|                                      | Child protection                            |
|                                      | Women                                       |
|                                      | Elderly                                     |
| Transport                            | Road network                                |
|                                      | Water transport                             |
|                                      | Seaports and airports                       |
| Water                                | River basins                                |
|                                      | Dams and reservoirs                         |
|                                      | Irrigation, drainage and control structures |
|                                      | Ground water extraction                     |
|                                      | River pumping                               |

Table 2.3: List of stock and flow subsectors within the Myanmar system (ADPC 2015).

## 2.5 Disturbances

At the essence of DRR comes the hazards, or disturbances, experienced by the system. While it has become increasingly recognised, the ‘fast’ versus ‘slow’ onset nature of disasters has an increasingly large role to play in disaster planning and readiness. These disasters correspond with the adaptive cycle of the Myanmar system, where the effects of slow disasters are often built up in the fore loop and released in the back loop phase, which is where infrequent disasters occur (often, these trigger the backwards release) (Gunderson et al. 2016).

Beyond their rate of acceleration or occurrence, disasters may also be classified on their disposition. ‘Characteristic disturbances’ are those that are known and can be predicted, such as ‘fast’ monsoon rains and ‘slow’ droughts during seasonal periods. Large, ‘infrequent disturbances’ are similar but are much rarer with a significantly greater impact (Uitto & Shaw 2015). These receive perhaps the most attention in DRR practices due to their widespread media coverage and aid campaigns. Yet before the Indian Ocean tsunami in 2004 and Cyclone Nargis in 2008, Myanmar experienced a majority of 87% casualties from ‘slow onset disasters’ such as famine and drought (Wisner et al 2004). This is in stark comparison to the 10% caused by floods and 4% due to earthquakes, tsunamis, and storms combined (Wisner et al. 2004). Unfortunately, with the increasingly pessimistic predictions on the effects of climate change, ‘unknown shock’ disasters will become much more of a threat to the world (Kreft et al. 2016). These differ from infrequent disturbances due to them never having occurred in a particular region in the past. Climate change will dramatically transform slow, onset and infrequent disasters, but due to alterations in the Earth’s climate patterns, DRR practice must now prepare for the unpredictable in many regions of the world. Myanmar is exposed to the following groups of disasters, regarding both natural and human-induced (ADPC 2015):

1. Fire, landslide, storm, flood, drought, earthquake, tsunami, avalanche, heat or cold wave, volcanic eruption, erosion of banks and shores.
2. Outbreak of contagious human diseases.
3. Pests or plant diseases, starvation, or outbreak of animal diseases.
4. Maritime, industrial, chemical or nuclear accident, oil spill, or leakage of natural gases.
5. Violence and armed insurgencies.

Myanmar’s north-south alignment has left it with both a tropical climate and strong altitude variations, naturally dividing it into “upper” and “lower” sections of the country (Leake 2013). Its terrain is composed of central lowlands surrounded by



rugged highlands, but as previously discussed it can be roughly grouped into three ecological regions: fertile Delta & coastal regions, central plains, and northern mountainous regions. Additionally, Myanmar has four seasons: a cool dry, hot dry, pre-monsoon and monsoon, with wetter areas along the coast experiencing less of a cool dry season (Leake 2013). The country's orientation leaves it with diverse topographical characteristics, so for DRR consideration these ecological regions have been organised in Table 2.4 alongside their corresponding hazards, seasonal impacts, and concerned government departments.

| <b><i>Hazard</i></b> | <b><i>Coastal<br/>Regions</i></b> | <b><i>Central<br/>Plains</i></b> | <b><i>Mountainous<br/>Regions</i></b> | <b><i>Seasonal<br/>Impacts</i></b> | <b><i>Government<br/>Agencies</i></b>                        |
|----------------------|-----------------------------------|----------------------------------|---------------------------------------|------------------------------------|--|
| Forest fire          |                                   |                                  |                                       | December to May                    | Forest Department  |
| City fire            |                                   |                                  |                                       | January to May                     | Fire Services Department                                     |
| Storm (surge)        |                                   |                                  |                                       | April, May, October                | Department of Meteorology & Hydrology (DoMH)                 |
| Riverine flood       |                                   |                                  |                                       | May to October                     | Irrigation Department, DoMH                                  |
| Flash flood          |                                   |                                  |                                       | May to October                     | DoMH   |
| Earthquake           |                                   |                                  |                                       | Year around                        | DoMH   |
| Landslide            |                                   |                                  |                                       | May to October                     | Ministry of Construction                                     |
| Drought              |                                   |                                  |                                       | December to May                    | DoMH, Dry Zone Greening Department                           |
| Tsunami              |                                   |                                  |                                       | Year around                        | DoMH   |
| Salt intrusion       |                                   |                                  |                                       | Year around                        | DoMH   |
| River bank erosion   |                                   |                                  |                                       | May to October                     | Development of Water Resources, Rivers and Creeks Department |
| Epidemic             |                                   |                                  |                                       | Year around                        | Public Health Department                                     |

Table 2.4: Ecological regions and hazards, seasonal impacts, and relevant government departments. (ADPC 2015).

## 2.6 Drivers and Trends

Figure 2.6 on page 28 provides a blueprint of the susceptible regions in Myanmar.

### 2.6.1 Flooding

Flooding has always been one of the primary natural hazards in Myanmar, with at least 459,000 people affected by those in 2015 alone (HCT 2016). Flooding leads to the loss of lives and property, damage to critical infrastructure, and economic loss. The rise of health problems is not uncommon, as water-borne diseases spread easily once lakes, ponds, and reservoirs become contaminated from uncontrolled flow and sewage. Myanmar receives the majority of its rainfall in the monsoon season between May and October, during which flooding and landslides are very common, particularly at peak monsoon season arriving in August (ADPC et al. 2009). Throughout this season, flooding frequents the main river delta regions while flash floods and landslides occur in the upper reaches of the river systems in mountainous regions. Coastal areas such as the Rakhine and Ayeyarwady coastlines constantly face the threat of sporadic flooding from cyclones and tropical storms from the Bay of Bengal throughout monsoon months (Figure 2.4). In urbanised areas, localised floods occur due to a combination of cloudburst, saturated soil, poor infiltration rates, and inadequate or poorly built infrastructure (for example, blocked or absence of drains) (Granger 2014). In rural areas, breakage of water flow structures as dams, dykes, and levees help to destroy valuable agriculture industry. Flash floods frequent rivers, caused by the heavy rainfall striking at the source water regions for considerable periods of time, often extending days (ADPC 2015).

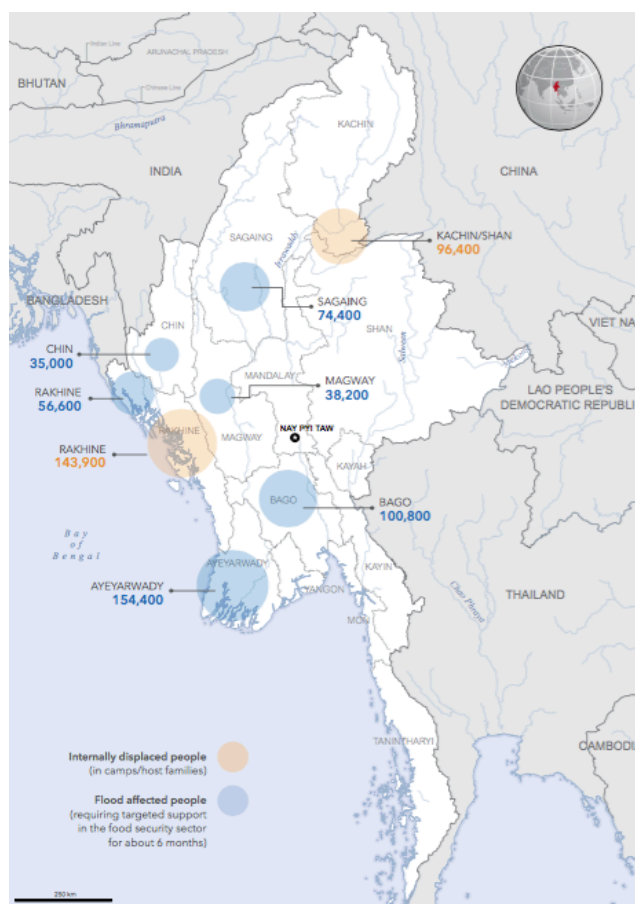


Figure 2.4: Internally displaced and flood affected peoples throughout Myanmar. (ADPC 2015).

mountainous regions. Coastal areas such as the Rakhine and Ayeyarwady coastlines constantly face the threat of sporadic flooding from cyclones and tropical storms from the Bay of Bengal throughout monsoon months (Figure 2.4). In urbanised areas, localised floods occur due to a combination of cloudburst, saturated soil, poor infiltration rates, and inadequate or poorly built infrastructure (for example, blocked or absence of drains) (Granger 2014). In rural areas, breakage of water flow structures as dams, dykes, and levees help to destroy valuable agriculture industry. Flash floods frequent rivers, caused by the heavy rainfall striking at the source water regions for considerable periods of time, often extending days (ADPC 2015).

## 2.6.2 Cyclones and Storm Surges

Myanmar is extremely susceptible to cyclones along its roughly 1,900km long coastline on the Bay of Bengal (CSO 2016). In the decade between 2002-2012, three major cyclones affected over 2.6 million people in the country, the most notable being Cyclone Nargis in 2008 (Government of the Union of Myanmar 2009). Nargis caused at least 140,000 deaths, with more assumed missing, in the Ayeyarwady Delta region, and property destruction estimated at over USD 4.1 billion (Oxford Burma Alliance 2014). The warm, moist air above the Bay of Bengal hosts a breeding ground for destructive storms such as Nargis that leaves Myanmar caught in the path of these natural hazards. The low-lying areas of Myanmar's Ayeyarwady Delta, interwoven with many tidal waterways, are naturally exposed to storm surges and monsoon winds blowing from the south-west (ADPC et al. 2009). Rising sea levels, stronger cyclones, and ecosystem degradation are linked and exacerbate the loss from coastal disasters (Deppisch & Hasibovic 2011).

## 2.6.3 Drought

The central regions of Magway, Mandalay, and lower Sagaing are home to the dry zones of Myanmar. They cover approximately 10 percent of the total area of the country, falling under arid to semi-arid as per different zonation and criteria (Figure 2.5) (ADPC et al. 2009). Dry zones are exposed to brief periods of intense rainfall and low annual rainfall totals, which results in the region's soils being extra sensitive to degradation due to a combination of low base fertility, high base salinity, low organic content. Desertification in the area is primarily driven by deforestation, erosion, and salinization (Mercy Corps 2014).

## 2.6.4 Earthquakes

Earthquakes in Myanmar are primarily a result of the collision between the Indian Plate subducting underneath the Burma (Eurasian) Plate. In the past 100 years, at least 20 major earthquakes have been measured in Myanmar (Somsard & Pailoplee 2013). The highly active Sagaing Fault line passing through middle of Myanmar has induced many of the deadly earthquakes, some as recently as August 2016 (SOURCE). Plates



Figure 2.5: Dry zone map of Myanmar (ADPC et al. 2009).

such as these have tensions build up over decades of pressure, and data shows that a major slip is soon overdue (Somsard & Pailoplee 2013).

### 2.6.5 Fires

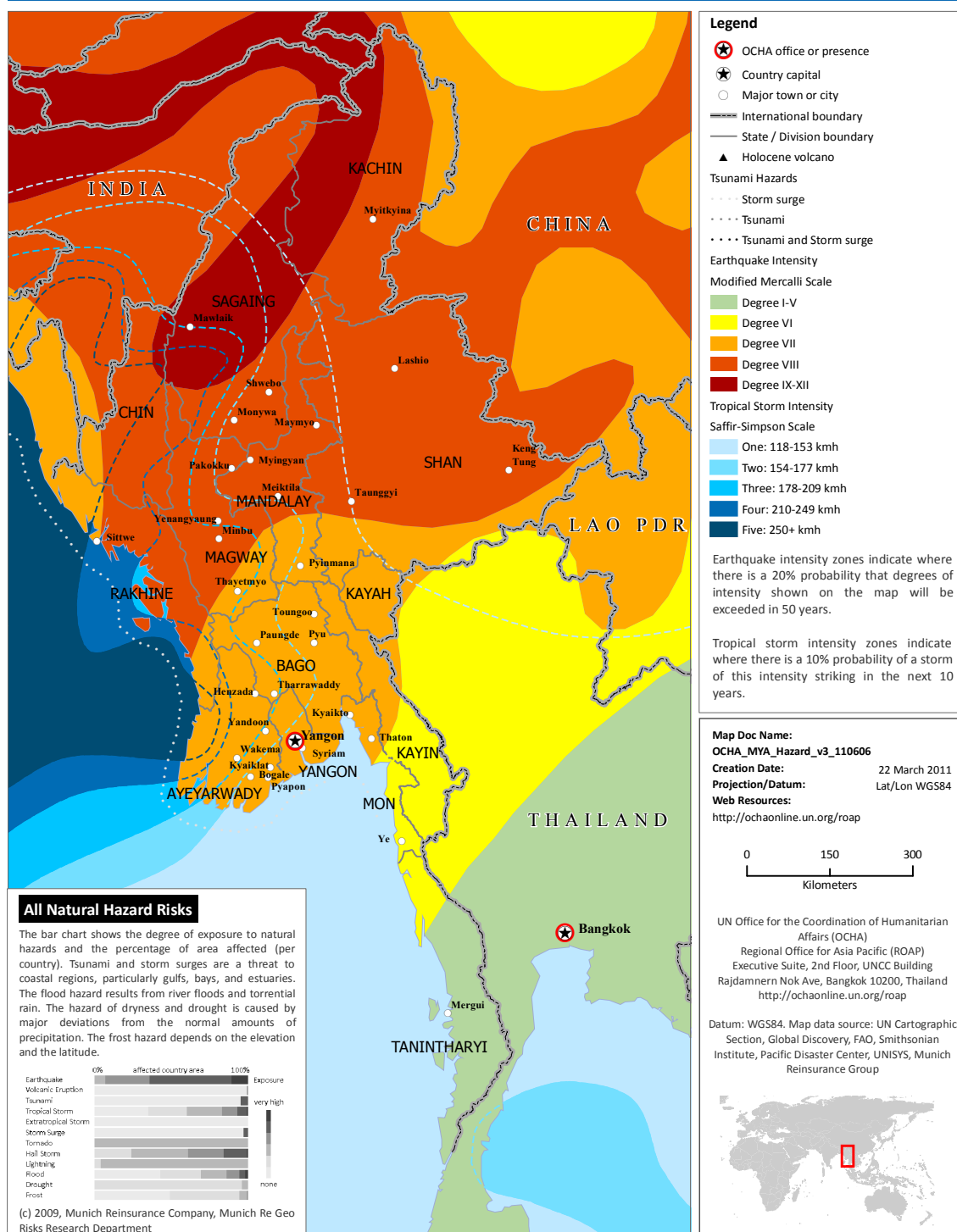
The number of fire hazard cases is trending downwards, yet the losses due to fire have still been increasing. The highest incidences of fires are concentrated mainly in Yangon, Mandalay, Ayeyarwady, Sagaing, and Bago. These Regions account for 63% of the total fire cases of the country, while their financial loss accounts for approximately 38% nationwide (ADCP et al. 2009). The main cause of fires is negligence stemming from households and intentional land management, accounting for almost 83% percent of cases. The early months of the year around February to May, the peak time of the dry season, are the most fire prone (ADCP et al. 2009).

### 2.6.7 Landslides

Landslides of various scales occur in the mountainous regions of Myanmar, particularly in the eastern Shan Plateau and Kachin ranges, as well as some of the eastern highlands. Western ranges experience devastating landslides particularly throughout the monsoon seasons, and as a by-product of cyclones (ADCP et al. 2009). Landslides in these regions are especially damaging to the high number of poorly regulated and unsafe mining operations found throughout the mountains (EarthRights International 2012).

## 2.7 Conclusion

The natural hazards facing Myanmar have proven to be more than troublesome for a country with so many infrastructural challenges already. While many are natural, it is important to recognise the other kind of disasters that may lead on from such disruptions to the natural system. The map in Figure 2.6 on the following page is supplied by the United Nations Office for the Coordination of Humanitarian Affairs and provides a clear layout of the high at risk regions to natural hazards throughout Myanmar. DRR support should be directed accordingly to those most in need or at particular risk.



The names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations

Figure 2.6: Natural hazard risk map of Myanmar (OCHA 2011).

## PART III: Activities and Funding

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### 3.1 Introduction

This historic point in time for Myanmar has left the door more open for opportunity and change than any time in recent history. Previous initiatives driven by the UNDP in its Human Development Index (HDI) 1993-2013 and Country Programme Action Plan (CPAP) 2013-2017 have developed critical guidance for development activities through these changing decades. This section hopes to apply some of these successes and challenges learned to the potential range of DRR and natural resource management activities that might follow step into Myanmar.

### 3.2 Decentralising

The national system of Myanmar is at a historically opportune point in time for change. The country has just seen decades of centralised, rigid military ruling in which it experienced the slow moving, exploitation phase build-up of its adaptive cycle. This phase of its fore loop (keeping in mind Figure 1.4 in Part I) has been followed by a rapid release phase of governmental change following the shock of widely accepted democratic elections in 2015 (DFAT 2016). It is the ensuing cycle period of reorganisation and rapid growth that Myanmar is now presented with as the country shifts towards democracy. This democratic reform has brought with it the much anticipated transfer to more decentralised decision-making (Ninh & Arnold 2016).

Decentralisation is not only pivotal in promoting democratic politics, but also in providing concise development initiatives in the changing socio-economic atmosphere. As these reforms continue to progress, the focal Township systems will hope to gain negotiating power with the Central government as interaction with internal and external actors increases. Within these actors will be the notable inclusion of a 25% quota of military representatives in the parliament and other levels of government, yet further interaction with international agencies such as the UN and World Bank has already been recognised (Ninh & Arnold 2016). Both sides of this dialogue must be recognised and utilised in development planning. For example, in a case study of DRR in the Yucatán peninsula of Mexico, Wilkinson (2012) found that two smaller municipalities with few financial resources underwent substantial improvements in most aspects of DRR, outperforming the larger municipalities that faced similar risks. This implies that factors beyond the level of funding determine the effectiveness DRR initiatives. In Mexico, decentralization and local governance proved to be critical in creating opportunities for more inclusive, effective approaches to reducing the risk of disasters.



### 3.3 Community Driven Development

It was implemented under a much more restrictive environment, yet the UNDP's HDI project was still successful in establishing community development by addressing the basic needs of impoverished communities with actions that supported sustainable livelihoods and improved access to social services, small village infrastructure, water, sanitation, and health services (UNDP 2016). It was able to establish interactive community mechanisms that supported rural development while improving the standard of living for these poor and vulnerable households. Building on this experience of social mobilization, support is needed for the institutional strengthening of local townships, governments, and civil societies to further more sustainable and inclusive forms of local development. The linking nature of these smaller scales intends for such community driven developments to translate upwards to higher models of regional and national government, as well as other independent partners.

Achieving this blend of knowledge and action in DRR, however, is often difficult. Many scientists and government officials often underestimate the value of local knowledge and community activities (Mercer et al. 2010). Conversely, local communities rarely have enough

Figure 3.1: Summarising community-stakeholder development (Mercer et al. 2010)

1. Initial community engagement,
2. Community vulnerabilities and drivers assessment,
3. Vulnerability reduction strategies,
4. Discourse and integration.

understanding of scientific knowledge, while NGO workers often claim that scientific research is disconnected from the reality. Such gaps between stakeholders, in terms of actions and knowledge, are a major obstacle for reducing the risk of disasters in a sustainable manner and on multiple scales (Wisner et al. 2004). Hoping to close this gap, Mercer et al. (2010) provide a notable four-step methodological framework. First, it requires initial engagement with the community to build confidence and trust in order to understand people's goals. Second, it includes an assessment of the community's vulnerabilities and drivers, which can be internal and/or external. Third, the method looks at potential strategies to reduce these vulnerabilities in the face of natural hazards. These strategies may rely on a combination of scientific and local knowledge. Finally, it provides space for both discourse and the integration of previously identified strategies so that bottom-up and top-down actions can be integrated for the risk reduction of disasters (Cadag & Gaillard 2011).

Projects in Myanmar must aim to build the capacity of local governments, including the self-administered zones, to implement area-based development planning and in turn responsive public services. A model comprised of integrated township development and the bolstering of local civil society and community learning centres will lead to better legal and civic awareness, as well as community services (UNDP 2013). At the same time, projects can strengthen local institutions by supporting

livelihood development through access to finance, vocational training and small enterprise development. The strengthening of social inclusion and therefore social capital will help to address many of systemic social issues surrounding gender equality and ethnic diversity (UNDP 2015). While diversity is often seen as a difficulty to overcome, it is in fact a valuable asset in community driven development programs. The diverse experiences and needs of Townships in the different regions of Myanmar will provide community projects with a range of perspectives if they are able to create tighter feedback (response) loops between the different human actors and their environmental outcomes. This communication will ideally translate into a system being able to adapt or transform before its undesirable thresholds are crossed. In these small-scale rural systems, locals are constantly aware of their dependence on the ecosystem's goods and services and how the fluctuations in these may affect their lives. Monitoring will tend to be constant and informal, yet development management actions will be consistent with local knowledge and taken in response to environmental fluctuations (Slootweg & Jones 2011). This feedback will continue linking rural consumers to the natural environment upon which they depend, greatly furthering the sustainable development of Townships. Projects need to be maintained in conjunction with the national and local stakeholders and remain flexible to their needs in order to successfully attain the trust that has made projects such as the UNDP's so successful (UNDP 2015).

*Figure 3.2: UNDP Human Development Initiative (HDI) Summary*

**Objectives:**

- Help communities to meet their basic needs, promote participation and participatory processes in community activities, and build local capacities and skills.

**Projects:**

- Integrated Household Living Conditions Assessment (IHLCA)
- Integrated Community Development Project (ICDP)
- Community Development for Remote Townships (CDRT)
- Sustainable Microfinance to Improve the Livelihoods of the Poor (MF)
- Enhancing Capacity for HIV/AIDS Prevention and Care Project (HIV/AIDS)

**Results:**

HDI supported 8,000 villages in over 60 townships nationwide, reaching an estimated 6 per cent of the population. It contributed to improved food security for 85,000 households and 427,000 people from poor rural and remote communities. Estimated 162,000 people supported by HDI achieved 10% yield increase in paddy and oil seeds, about 97,000 people achieved 25% income increase from livestock raising and over 142,000 people had at least 3 additional food secure months from food banks. An estimated 570,000 people had access to microfinance services. ICDP and CDRT supported the formation and strengthening of 5,473 Self-Reliance Groups, where women from poor households increased financial and social capital and improved their decision making roles in both family and village affairs. (UNDP 2016)



### 3.4 Stakeholder Coordination

DRR and resource management projects should aim to establish, strengthen and utilise partnerships with the Central Government particularly at the Township level, but also at the national and regional levels. Development partners and other non-state actors should also be coordinated in order to extend the effectiveness, efficiency relevance, and sustainability of development projects. In order to strengthen the national acceptance and usefulness of program results, projects should aim to support existing priorities and policy frameworks of Myanmar, such as some of the example suggested in Table 3.1. By aligning activities with ministerial plans, development initiatives can be sustainably carried forward by national counterparts in the long-term. Close partnerships with sections of parliament and judiciary will be important in order to improve the policy and regulatory environment for areas of activity. Tight-knit partnerships with local Township governments will help to ensure this alignment with state and regional development plans and help to encourage long-term sustainability of these local governance institutions. The GAD will serve as an invaluable partner in coordinating various government bodies due to its effectiveness and efficiency operating at the focal Township levels (Chit Saw & Arnold 2016).

| <b>Sector</b>  | <b>National Priorities and Frameworks</b>  | <b>Government Counterparts</b>   |
|--|--|--|
| <i>Inclusive Community Development</i>                         | National Strategy on Rural Development and Poverty Alleviation                           | Ministry of Home Affairs;<br>Ministry of Border Affairs;<br>Region and State governments   |
| <i>Disaster Risk Reduction and Natural Resource Management</i> | Myanmar Action Plan on Disaster Risk Reduction;<br>Standing Order on Disaster Management | Ministry of Social Welfare, Relief and Resettlement;<br>Ministry of Environmental Conservation and Forestry;<br>Ministry of Border Affairs;<br>Ministry of Transport |
| <i>Governance and Development Effectiveness</i>                | National Framework for Socio-Economic Reforms  | Ministry of National Planning and Economic Development   |

Table 3.1: Existing national priorities, frameworks, and government counterparts (UNDP 2015).

Partnerships between development partners, and synergising with other development and aid programs, will lead to more efficient program rollout and will improve the endurance of all the involved programs. These development partners will benefit from each other's global and local expertise, and the respective broad network of partnerships. Entering into partnership agreements may potentially leverage donor resources for program cost-sharing on those with similar fields of action. An example of this would be making use of the national census supported by the United Nations Population Fund (UNFPA), which could help to extend the ability to address community and environmental challenges (UNDP 2015). Additionally, the coordination of activities between development banks to will ensure cooperation at

local levels and avoid overlaps in assistance to the Central and sub-national governments (Battencourt et al. 2013). Private sector, academia, and research institutions will also bring valuable partnerships forward to deliver program results in sustainable, effective, and efficient methods (UNISDR 2004). Organisations such as IID should be utilised not only for efficient program action but also as partners in support of democratic, decentralised governance. Joint programs with such organisations will leverage deep ranges of intellectual and technical expertise. A diversity of partnerships will reinforce the flexibility needed to effectively address a range of DRR and management issues.

### 3.5 Natural Defence Conservation

The promotion and sustaining of diversity extends beyond social and economic boundaries to the biological realm. By embracing ecological variability rather than controlling it, general resilience will be built upon as opposed the highly susceptible practice of specific resilience (Walker & Salt 2012). There is a growing movement of environmental restoration that hopes to re-establish lost ecosystem functions, such as the natural flood protection provided by forest and mangrove populations in the Ayeyarwady Delta region (Leake 2013). The map of Figure 3.4 shows widespread agricultural deforestation of the Delta, which has reduced the natural capital of the region drastically. Immense benefits would result from a community driven project aimed to rebalance the region with diverse nature and landscape improvements. Community forestry projects such as those discussed by Tint et al. (2011) would put ownership in the hands of

community Forest User Groups and shift the direction of deforestation. Cadag and Gaillard's (2011) 3D participatory risk mapping in the Philippines is another initiative that successfully integrates scientific and local knowledge within a DRR space to involve a range of stakeholders. Slow variables such as nutrient, carbon and water cycles will also be identified as projects such as these lead to open stakeholder knowledge exchanges.

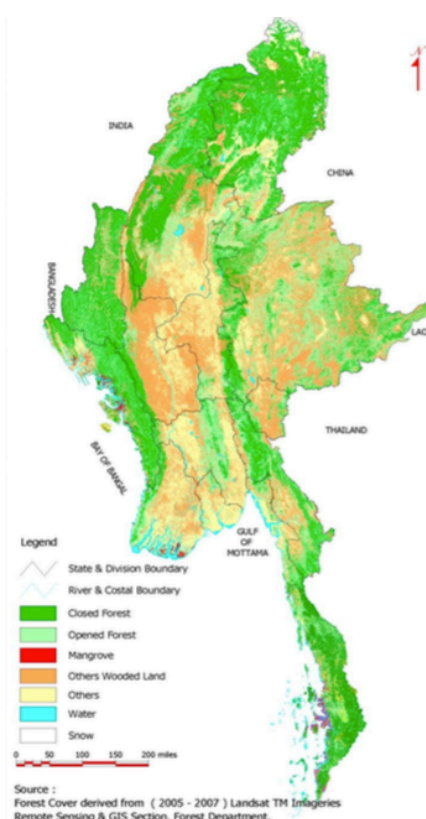


Figure 3.3: Forest cover status of Myanmar 2007 (Tint et al. 2011).

### 3.6 Mainstreaming DRR

One must always remember that each total risk is specific to a given location, therefore rendering the other three components of risk (hazard, elements at risk, vulnerability) also unique (Grander 2014). It is the nominal goal of DRR to reduce risk in any location as much as possible through preventative measures. Unfortunately, the majority of conventional international disaster response efforts gain traction in the aftermath of large, ‘fast’ moving disasters. Evidently, the World Bank’s Global Facility for Disaster Reduction and Recovery (GFDRR) provides general cost estimates for ‘building back better’ after disasters have occurred in Table 3.2.

| Sector   | Building Back Better Factor |
|--|-----------------------------|
| Housing  | 1.10–1.35                   |
| Schools  | 1.10–1.50                   |
| Hospitals  | 1.10–1.50                   |
| Agriculture/Livestock and Fisheries Infrastructure | 1.10–1.40                   |
| Industrial Facilities                              | 1.10–1.40                   |
| Commerce and Trade                                 | 1.10–1.35                   |
| Water and Sanitation                               | >1.00*                      |
| Transport  | >1.00*                      |
| Electricity  | >1.00*                      |
| Communications                                     | >1.00*                      |

Table 3.2: Cost estimates for ‘building back better’ post-disaster (Battencourt et al. 2013).

Costs of building back better = Replacement Costs x Building Back Better Factor and Building Back Better Factor = Costs of Quality Improvements + Technological Modernization + Relocation to Safer Areas (if needed) + Disaster Risk Reduction Standards + Multiannual Inflation

\*Note: Factors for infrastructure sectors vary highly depending on the choice of reconstruction

While the costs of developing resilient infrastructures and systems from the beginning may exceed costs of cheaper, less efficient methods, in a conflict-ridden nation such as Myanmar, you will certainly get what you pay for. ‘Rebuilding better’ in Table 3.2 \_ at the minimum requires more than the initial costs in every category. While Myanmar will gain direct economic benefits by mainstreaming DRR into initial development, it will also gain the indirect economic benefits of its pre-emptive risk management. Table 3.3 demonstrates just a few of the economic gains realised through various sustainable developments.

| <b>Disaster Risk Reduction Activity</b>             | <b>Extended Economic Benefits</b>  |
|---|--|
| Flood protection structures                         | Provision of irrigation or potable water and hydroelectric power                                       |
| Improvements in civil society networks and linkages | Improved governance and more organized social structures   |
| Proper planning processes                           | Delivery of basic necessities (ex. potable water, drainage, sewerage, power, and community facilities) |
| Shelters  | Community facilities (ex. clinics or schools) in non-disaster periods                                  |
| Improved water supply systems in rural areas        | Water supply systems improved regardless of a disaster occurring                                       |
| Construction and use of drainage pipes              | Improved irrigation practices, possibly improved agricultural practices                                |
| Community-based disaster preparedness               | Improved women's involvement in community level activities   |
| Installing more resilient wireless communications   | Enhancing access to telephone and electronic data services   |
| Training farmers to diversify the use of crops      | Reducing vulnerability to poverty  |
| Better monitoring of food supplies                  | Improving the food supply chain, possibly making it more cost-effective                                |

Table 3.3: Potential economic gains realised through sustainable development (Vorhies 2012).

The benefits provided in Table 3.3 do not all amount specifically to numerical financial gains. However, they can clearly be said to better any society that takes such actions. The forms of capital discussed in Part I of this report present themselves in sustainable development as reserves within the system. By undertaking activities such as those suggested above, social, financial, productive, natural, and human reserves will be stored at the ready for when shocks do occur, as opposed to the widespread practice of throwing financial capital forward once a response is required post-disaster. If practices such as these are mainstreamed into the initial development processes of Myanmar (again noting its current opportune growth stage), cost savings will be maximised when compared to post-disaster relief expenses. More specific funding expenditure is presented in Table 3.4, from the first two years of UNDP's CPAP. By following a similar program structure, sustainable developments will have room to revert far more spending to areas of environmental governance and disaster resilience, as the initial frameworks for local governance and community driven action will have been established by these pre-existing plans (UNDP 2015).

Table 3.4: Delivery spending by Outcome Area (US\$000) for years 2013 and 2014 of UNDP CPAP (UNDP 2015).

| <b>Outcome area</b>                                     | <b>2013</b>  | <b>2014</b>   |
|---|--------------|---------------|
| <i>Local Governance</i>                                 | 17,106       | 11,060        |
| <i>Environmental Governance and Disaster Resilience</i> | 1,277        | 1,631         |
| <i>Democratic Governance</i>                            | 3,240        | 5,446         |
| <b>TOTAL</b>  | <b>2,624</b> | <b>18,137</b> |

### 3.7 Conclusion

A World Bank paper on the benefit cost-analysis of disaster risk reduction in developing countries has concluded that the net benefits of retrofitting are likely to be higher where initial building standards are lower (Markandya & Pedroso-Galinato 2009). Such is the case in the developing country of Myanmar. The quality of existing infrastructure such as housing, hospitals, roads, bridges, and schools is likely to be subpar compared to that of its developed international counterparts. Hence, the net economic benefits of pre-emptive DRR measures may be significant. If the forms of financial, natural, produced, human, and social capital that directly and indirectly result from these measures are brought into the equation, the value of mainstreaming of DRR into development is evident.

## Recommendations and Conclusion

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In a world where climate change is becoming an inevitable challenge to global livelihoods, vulnerable countries such as Myanmar cannot afford to delay action any further. Climate change is coming, and the world must become more adaptive to any type of disaster, even in areas historically unscathed.

The first section of the report establishes an overview of DRR and resilience thinking in order to frame the recommended strategy. The identity concept of self-organising systems such as Myanmar is a critical foundation in understanding adaptive cycles and the interaction between scales. Forms of capital beyond the financial realm help to widen the understanding of direct and indirect repercussions.

Secondly, the socio-ecological landscape of Myanmar is outlined with specific attention paid to the threats facing the country system. This helps to explain the significance of acting from the Township level of government within the GAD operational body.

Finally, the report builds recommendations to be considered by institutional partners and donors. Decentralisation, community-driven development, stakeholder coordination, natural defence conservation, and mainstreaming DRR are all crucial factors to future sustainable development action.

## Recommendations

The following recommendations are made for improving the resilience of Myanmar through DRR and associated activities:

- Promote diversity in decision-making and DRR programs in order to ensure overall development sustainability
- Continue to further decentralised decision-making processes in conjunction with the democratic changes taking place in the Myanmar government hierarchy, with a focus on the Township level, so that personal accountability remains relevant
- Encourage community driven development programs, also alongside the democratic changes, in order to increase social capital and community trust and confidence
- Create close feedback and interconnected processes between communities and stakeholders to gain efficiency, relevancy, and maintain community trust
- Coordinate a range of relevant stakeholder activities through the General Administration Department of Myanmar, with its widespread presence amongst the population
- Aim to mainstream DRR into development practices for significant investment cost-savings and efficiency

## Conclusion

Myanmar's past nature of seclusion and mistrust is quickly reshaping itself as it opens its doors open to democracy and global investment. The timing for change has perhaps never been more opportune, yet deeper community research on the ground must continue on from the general discussion generated by reports such as this. Criteria for resilient communities should be established for locals and their states, opening the door for more aid, investment, and federal grant opportunities. History has shown that resilience will always be tested, but if disturbances and shocks are planned for, perhaps we will one day gain the ability to extensively minimise both the fast and slow moving consequences of disasters.



## References

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ADPC 2009, *Institutional Arrangements for Disaster Management in Myanmar*, Asian Disaster Preparedness Center.

ADPC 2015, *Roadmap for Risk Assessment, Myanmar*, viewed 1 August 2016, <[http://www.adpc.net/igo/category/ID937/doc/2015-x1SFw3-ADPC-Myanmar\\_Risk\\_Assessment\\_Roadmap.pdf](http://www.adpc.net/igo/category/ID937/doc/2015-x1SFw3-ADPC-Myanmar_Risk_Assessment_Roadmap.pdf)>.

ADPC, MIMU, MGS, MES, & Union of Myanmar 2009, *Hazard Profile of Myanmar*, viewed 3 September 2016, <[http://www.preventionweb.net/files/14567\\_14567HazardReport25.8.091.pdf](http://www.preventionweb.net/files/14567_14567HazardReport25.8.091.pdf)>.

Akhtar, S 2016, *Transforming commitment into action on disaster risk reduction*, Japan Today, viewed 8 August 2016, <<https://www.japantoday.com/category/opinions/view/transforming-commitment-into-action-on-disaster-risk-reduction>>.

Aldrich, M & Sayer, J 2007, *Landscape Outcomes Assessment Methodology "LOAM" - In Practice*, WWF Forests for Life Programme, WWF.

Annan, K 1999, *Facing the humanitarian challenge: Towards a culture of prevention*, United Nations Department of Public Information, New York.

Battencourt, S, Ebinger, J, Fay, M, Ghesquiere, F, Gitay, H, Krausing, J, Kull, D, McCall, K, Reid, R & Simpson, A 2013, *Building resilience: integrating climate and disaster risk into development - the World Bank Group experience*, Main Report, World Bank, Washington, DC, viewed 1 August 2016, <<http://documents.worldbank.org/curated/en/762871468148506173/Main-report>>.

BRACED 2015, *Community Resilience Assessment and Action Handbook*, BRACED Myanmar Alliance, Yangon, viewed 22 September 2016, <<http://www.braced.org/resources/i/?id=127foe24-a44a-4468-abca-96db853f6558>>.

Briceño, S 2015, "Looking Back and Beyond Sendai: 25 Years of International Policy Experience on Disaster Risk Reduction", *International Journal of Disaster Risk Science*, vol. 6, no. 1, pp. 1-7.

Cadag, J & Gaillard, J 2011, "Integrating knowledge and actions in disaster risk reduction: the contribution of participatory mapping", *Area*, vol. 44, no. 1, pp. 100-109.

Centre for Economic & Social Development 2013, *Framework for Economic and Social Reforms (FESR)*, viewed 22 September 2016, <<http://www.eaber.org/sites/default/files/FESR%20Official%20Version%20-%20Green%20Cover.pdf>>.

Chit Saw, K & Arnold, M 2016, *Administering the State in Myanmar: an Overview of the General Administration Department*, Subnational Governance in Myanmar Discussion Paper Series, The Asia Foundation, Yangon.



Chrilton, D 1999, 'The risk triangle, in J Ingleton (ed), *Natural disaster management*, Tudor Rose, London.

CIA 2016, *The World Factbook - Burma*, viewed 1 August 2016, <[https://www.cia.gov/library/publications/the-world-factbook/geos/print\\_bm.html](https://www.cia.gov/library/publications/the-world-factbook/geos/print_bm.html)>.

Cosgrove, J 2007, *Synthesis Report: Expanded Summary*, Joint evaluation of the international response to the Indian Ocean tsunami, Tsunami Evaluation Coalition.

CSO 2016, *Myanmar in Brief*, Central Statistical Organization, Ministry of Planning and Finance, viewed 3 August 2016, <<http://www.csostat.gov.mm/Myanmar.asp>>.

Department of Population 2015, *Census Report Volume 2*, The 2014 Myanmar Population and Housing Census, Nay Pyi Taw.

Deppisch, S & Hasibovic, S 2011, "Social-ecological resilience thinking as a bridging concept in transdisciplinary research on climate-change adaptation", *Natural Hazards*, vol. 67, no. 1, pp. 117-127.

DFAT 2016, *Myanmar country brief*, Department of Foreign Affairs and Trade, viewed 13 August 2016, <<http://dfat.gov.au/geo/myanmar/Pages/myanmar-country-brief.aspx>>.

EarthRights International 2012, *Where the Change Has Yet to Reach: Exposing Ongoing Earth Rights Abuses in Burma*, EarthRights International, Washington, DC.

Goodwin, N 2003, *Five kinds of capital: Useful concepts for sustainable development*, Medford, Tufts University.

Granger, K 2014, *Disaster Risk Assessments for Local Governments: A Practitioner's Guide*, Environmental Risk Science and Audit.

Gunderson, L, Kinzig, A, Quinlan, A, Walker, B, Cundhill, G, Beier, C, Crona, B & Bodin, Ö 2016, *Assessing Resilience in Social-Ecological Systems: Workbook for Practitioners*, Resilience Alliance, viewed 29 September 2016, <<http://www.resalliance.org/3871.php>>.

Gunderson, L and Holling, S (eds.) 2002, *Panarchy: Understanding transformations in human and natural systems*, Island Press, Washington, DC.

HCT 2016, *Myanmar Humanitarian Needs Overview 2016*, UN Office for the Coordination of Humanitarian Affairs, viewed 5 September 2016, <<http://reliefweb.int/report/myanmar/myanmar-humanitarian-needs-overview-2016>>.

Holling, C 2004, "From Complex Regions to Complex Worlds", *Ecology and Society*, vol. 9, no. 1.

Kenny, C 2012, "Disaster risk reduction in developing countries: costs, benefits and institutions", *Disasters*, vol. 36, no. 4, pp. 559-588.

Kreft, S, Eckstein, D, Dorsch, L & Fischer, L 2016, *Global Climate Risk Index 2016: Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2014 and 1995 to 2014*, Germanwatch e.V., viewed 21 August 2016, <<http://www.germanwatch.org/en/cri>>.

Ku, P 2014, *Quarter 2 2014: Lessons Learned & Recommendations*, Quarterly Report (April-June) Annex III.

Leake, J 2013, *Cyclone Nargis, Myanmar*, 1st edn, Thaksin University Press, Bangkok.

Markandya, A & Pedroso-Galinato, S 2009, *Economic Modeling of Income, Different Types of Capital and Natural Disasters*, Policy Research Working Paper 4875, The World Bank.

Mercy Corps 2014, *The Dry Zone of Myanmar: a strategic resilience assessment of farming communities*, MercyCorps, Portland, viewed 12 September 2016, <[https://www.mercycorps.org/sites/default/files/MercyCorps\\_DryZoneStudyMyanmar\\_2015.pdf](https://www.mercycorps.org/sites/default/files/MercyCorps_DryZoneStudyMyanmar_2015.pdf)>.

MIMU 2016, *Disaster Risk Reduction Sector*, Myanmar Information Management Unit, viewed 8 August 2016, <<http://www.themimu.info/sector/disaster-risk-reduction>>.

MIMU 2016, *Myanmar Administrative Structure*, Myanmar Information Management Unit, viewed 8 August 2016, <[http://www.themimu.info/sites/themimu.info/files/documents/Myanmar\\_Administrative\\_Structure\\_Aug\\_2015.pdf](http://www.themimu.info/sites/themimu.info/files/documents/Myanmar_Administrative_Structure_Aug_2015.pdf)>.

Mercer J, Kelman I, Taranis L, Suchet S 2010, 'Framework for integrating indigenous and scientific knowledge for disaster risk reduction', *Disasters*, vol. 34, no. 1, pp. 214-239.

Moench, M, Mechler, R & Stapleton, S 2007, *Information Note No 3 Costs and benefits of disaster risk reduction*, Global Platform for Disaster Risk Reduction, High Level Dialogue, viewed 29 October 2016, <<https://www.unisdr.org/we/inform/publications/1084>>.

Ninh, K & Arnold, M 2016, "Decentralization in Myanmar: a nascent and evolving process", *Journal of Southeast Asian Economies*, vol. 33, no. 2, p. 224.

Nixon, H, Jolene, C, Saw, K, Lynn, T & Arnold, M 2013, *State and Region Governments in Myanmar*, The Asia Foundation.

OECD 2016, *Burma (MMR) Exports, Imports, and Trade Partners*, Atlas.media.mit.edu, viewed 13 September 2016, <<http://atlas.media.mit.edu/en/profile/country/mmr/#Exports>>.

Oxford Burma Alliance, 2014, *Cyclone Nargis*, viewed 13 August 2016, <<http://www.oxfordburmaalliance.org/cyclone-nargis.html>>.

Parker, R 2006, *Hazards of nature, risks to development: an IEG evaluation of World Bank assistance for natural disasters*, World Bank, Washington, DC, viewed 29 October 2016, <<http://documents.worldbank.org/curated/en/396321468161661084/Hazards-of-nature-risks-to-development-an-IEG-evaluation-of-World-Bank-assistance-for-natural-disasters>>.

Parks, T & Cole, W 2010, *Political Settlements: Implications for International Development Policy and Practice*, The Asia Foundation.

Rieffel, L & Fox, J 2013, *Too Much, Too Soon? The Dilemma of Foreign Aid to Myanmar/Burma*, Nathan Associates Inc., Arlington.

Rubin, M in Rocket, W & Wine Wai Wai Win 2014, 'Picturing: The Promise of Libraries in Myanmar', *The Asia Foundation*, viewed 27 November 2016, <<http://asiafoundation.org/2014/04/02/picturing-the-promise-of-libraries-in-myanmar/>>.

Sarsycki, M & Towashiraporn, P 2015, *Effective Communication of Flood Risk Information for Improved Decision Making in Rakhine State, Myanmar*, viewed 13 September 2016, <<http://isepei.org/case-studies/effective-communication-flood-risk-information-improved-decision-making-rakhine-state>>.

Schultz, L, Folke, C & Olsson, P 2007, "Enhancing ecosystem management through social-ecological inventories: lessons from Kristianstads Vattenrike, Sweden", *Environmental Conservation*, vol. 34, no. 02, p. 140.

Slootweg, R & Jones, M 2011, "Resilience thinking improves SEA: a discussion paper", *Impact Assessment and Project Appraisal*, vol. 29, no. 4, pp. 263-276.

Small-Lorenz, S, Stein, B, Schrass, K, Holstein, D & Mehta, A 2016, *Natural Defences in Action: Harnessing Nature to Protect Our Communities*, National Wildlife Federation, Washington, DC.schef

Smith, M & Allsebrook, A 1994, *Ethnic Groups in Burma: Development, Democracy and Human Rights*, Anti-Slavery International, London.

Somsard, N & Pailoplee, S 2013, "Seismic Hazard Analysis for Myanmar", *Journal of Earthquake and Tsunami*, vol. 07, no. 04.

The Government of the Union of Myanmar, 2009, *Myanmar Action Plan on Disaster Risk Reduction (MAPDRR) 2009-2015*, viewed 16 August 2016, <<http://preventionweb.net/go/18657>>.

Tint, K, Springate-Baginski, O & Gyi, M 2011, *Community Forestry in Myanmar: Progress and Potentials*, Ecosystem Conservation and Community Development Initiative, Yangon.

Tint, K, Springate-Baginski, O, Macqueen, D & Gyi, M 2014, *Unleashing the potential of community forest enterprises in Myanmar*, Conservation and Community Development Initiative (ECCDI), University of East Anglia (UEA) and International Institute for Environment and Development (IIED), London.

Uitto, J & Shaw, R 2015, *Sustainable Development and Disaster Risk Reduction*, 1st edn, SpringerLink (Online service) Content Provider.

UNDP 2012, *Mainstreaming HR in Development Policies and Programming: UNDP Experiences*, United Nations Development Programme.

UNDP 2013, *Country Programme Action Plan (2013-2015) Between the Government of the Republic of the Union of Myanmar and the United Nations Development Programme*.

UNDP 2014, *Bridges to Justice: Rule of Law Centres for Myanmar*, viewed 2 October 2016, <[http://www.mm.undp.org/content/myanmar/en/home/library/democratic\\_governance/bridges-to-justice.html](http://www.mm.undp.org/content/myanmar/en/home/library/democratic_governance/bridges-to-justice.html)>.

OCHA 2011, *Myanmar: Natural Hazard Risks*, United Nations, viewed 21 October, <[http://reliefweb.int/sites/reliefweb.int/files/resources/map\\_1303.pdf](http://reliefweb.int/sites/reliefweb.int/files/resources/map_1303.pdf)>.

UNDP 2015, *Myanmar Country Programme - Country Programme Action Plan 2013-2017: Independent Midterm Evaluation*.

UNDP 2016, *About Myanmar*, UNDP in Myanmar, viewed 30 August 2016, <<http://www.mm.undp.org/content/myanmar/en/home/countryinfo.html>>.

UNDP 2016, *Human Development Initiative*, UNDP in Myanmar, viewed 30 August 2016, <[http://www.mm.undp.org/content/myanmar/en/home/operations/projects/poverty\\_reduction/HDI.html](http://www.mm.undp.org/content/myanmar/en/home/operations/projects/poverty_reduction/HDI.html)>.

UNDP, 2016, *Local Governance Mapping*, UNDP in Myanmar, viewed 31 August 2016, <[http://www.mm.undp.org/content/myanmar/en/home/operations/projects/poverty\\_reduction/LocalGovernancePillar1/local-governance-mapping.html](http://www.mm.undp.org/content/myanmar/en/home/operations/projects/poverty_reduction/LocalGovernancePillar1/local-governance-mapping.html)>.

UNISDR 2004, *Living with risk: a global review of disaster reduction initiatives*, United Nations Office for Disaster Risk Reduction, viewed 12 September 2016, <<http://www.unisdr.org/we/inform/publications/657>>.

UNISDR 2005, *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*, United Nations, Geneva.

UNISDR 2015, *Sendai Framework for Disaster Risk Reduction 2015-2030*, United Nations, Geneva.

Vorhies, F 2012, *The economics of investing in disaster risk reduction*, Secretariat to the UN International Strategy for Disaster Reduction, Geneva.

Walker, B & Salt, D 2012, *Resilience practice*, Island Press, Washington, DC.

Wilkinson, E 2012, "Why 'small is beautiful' in municipal disaster risk reduction: Evidence from the Yucatán peninsula, Mexico", *Environmental Hazards*, vol. 11, no. 2, pp. 155-171.

Wisner, B, Blaikie, PT & Cannon, DI 2004, *At Risk: Natural hazards, people's vulnerability and disasters*, 2<sup>nd</sup> ed., Routledge, London.