

Wanglin Yan · Will Galloway *Editors*

# Rethinking Resilience, Adaptation and Transformation in a Time of Change

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# Foreword

With change become a fact of our modern life the timing of this collection could not be any better. How the world deals with large and serious problems is almost certainly going to shape our collective future. The problems are very challenging indeed, including such things as global emigration that result from a host of causes, from climate change, to war, or economics. As populations increase and urbanize the world over the chance that disaster will impact on our lives grows ever more likely.

In this context, responding to disaster is difficult. Preparing for disaster is even harder. This book offers the lessons of practitioners who are trying to do both, and as such the breadth of topics and expertise is substantial.

The editors, both based in Japan, began their work on the subject of resilience in the context of global climate change, but were forced to rethink their direction when the country was struck by an enormous earthquake and tsunami in March of 2011. By chance they had just begun to develop the Environmental Innovators Program at Keio University and had the chance to shape the content of the program so the problems of managing large scale disaster could be placed at the centre. Building on that decision they invited practitioners from around the world, although mostly from Asia, to discuss both successes and failures with building resilience before and after disaster.

The book provides a number of ideas that can be generalized towards understanding the topic of resilience and how it relates to adaptation and change. Because the articles are written by practitioners there is a strong bias towards the minutiae of quite specific topics. However, the collection as a whole works to bridge theory and practice. Taken together they aim for a holistic understanding of resilience, and search for guidance on how to plan for the long term, and how to become meaningfully proactive without losing flexibility. As such the book is a useful introduction to the meaning of resilience in the age of climate change; where the effects of disaster, whether natural or man-made, are regional if not global, and complicated by local issues that need to be solved at the same time to be truly effective.

Collections such as these will be ever more important as we strive to develop better policies and take better precautions to become more resilient both for today and into the future. I hope this is only the first of a series of books that will allow our leaders and practitioners to make strong evidence based decisions going forward.

Yoshitsugu Hayashi  
Professor Emeritus of Nagoya University,  
Full member of the Club of Rome

# Acknowledgements

The authors of this book all share the experience of speaking at a series of workshops and symposiums held at Keio University in Tokyo, Japan, from 2011 to 2014. The timing of these gatherings is significant because the editors, and many of the contributors, were in Japan during the massive disaster that struck the northern coast of the country in March 2011. The disaster was remarkable not only for its size, but also because it starkly exposed the contradictory fragility and strength of the country and its communities. At the time we had already planned and started a series of events that would focus on climate change adaptation. We would invite leaders who were active in the field, including architects, scientists, and governmental agents and try to build a consensus on how to work across disciplines in the real world. Faced with the raw brutality of the disaster and its long-term consequences, we immediately modified our plans. Keeping the basic structure our focus moved towards understanding resiliency and more specifically we asked contributors to talk about the actions that might be taken to build resiliency both before and after a disaster takes place. In hindsight this shift was not so large, because the real topic is change, and how to deal with it in a positive way.

The goal of this book then is to share the lessons gathered over 4 years and to shed some light on some of the tools and the recent understanding of adaptation and resiliency in a global context. It is also intended to underline the developing meaning of resilience and its use as a tool for advancing positive change.

We would like to thank William Siembieda, Sander Ernst Van der Leeuw, and Krishne Gowda for their efforts to make the book as clear as possible. Also we are indebted to The Environmental Leaders Program and the financial support from MEXT (The Japanese Ministry of Education, Culture, Sports, Science and Technology) that supported it. The Research Center of Keio University at Shonan Fujisawa Campus offered additional support through the project. Finally, we owe a great deal of thanks to the students and staff in the Environmental Leaders Program, including Ryo Uemtasu, Takafumi Miyasaka, Mayumi Aida, and Mie Iijima.

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**Part I**  
**Introduction**

# Chapter 1

## Understanding Change Through the Lens of Resilience

Wanglin Yan and Will Galloway

**Abstract** Though change is often problematic and complicated by circumstance, and in the case of disaster profoundly damaging, it can also be an opportunity to improve otherwise intractable systemic problems. With that in mind, this chapter defines the nature of change as viewed through the lens of resilience and further outlines the relationship between resilience, adaptation, and transformation. Because change is often negative, strategies to build resilience are rationally directed towards coping with its consequences or resisting it outright. Similarly, because change is complicated, with many inter-connected parts, it is difficult to prepare for even when its causes are well understood. Most contemporary theories of resilience recognize the role of complexity, risk and vulnerability, but there is not yet a strong understanding of how to manage change as it impacts groups differently across scales, from local communities to regions, or even nations. The authors propose that resilience planning and theory can be improved by acknowledging the complexities of the adaptive cycle and panarchy in particular. The chapters of the book are offered as case studies and amplification of this idea, either in practice or in theory, from the perspective of multiple fields. The point of view is global, but includes informative chapters written by Japanese contributors who focus on the unprecedented change brought about by the 2011 Tohoku disaster in northern Japan. This perspective is often missing in such collections primarily because of the language barrier.

### A Time of Change

Change never takes us where we expect.

This book nonetheless looks at how change, planned or otherwise, can be used in a positive way. One of the more important lessons of our time may be the simple

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recognition that change is not a process that can be easily quantified or managed. Ironically it is more likely that coming to terms with our inability to predict the future is a key step in learning to adapt to uncertainty. It is not clear that we have taken that step in enough places yet, but there are positive signs in that direction, some of which are presented here.

Why is this topic important? Once it may not have mattered so much how people managed change, because it was mostly a local issue, with local impacts. Today, change is global and inescapable. Economics, energy production and trade are interconnected across the globe, as are climate change, pollution and, sadly, war. As a result, isolating problems to a single source is difficult, making them hard to resolve, or even to understand. On the other hand, that same interconnectivity can be helpful. It means for instance that recent efforts to manage climate change adaptation on the plains of Mongolia can be productively grouped with a discussion on the role of community in rebuilding after disaster in the United States. The group of articles collected here is built on that insight. While there is a diversity of themes they are held together by a shared experience with adapting to change and the problem of how to build resiliency in the real world.

## **Resilience and Change**

Responses to change depend on the attitude of the stakeholders. When the scale of the event is large, as in a natural disaster or social crisis, the tendency is to work reactively, taking action only after there is visible damage and an urgent need. This kind of activity can be seen as a form of coping and includes policies and systems that deal with natural hazards, disasters and social crises after the fact. Alternatively, it is possible to take action pro-actively. Proactive responses include behaviours that optimize future choices by keeping options open and by aiming to create opportunity in advance of actual need (Newman and Dale 2005). Currently most change is dealt with after the fact, and is reactive, as we might see in the efforts to rebuild a city after a natural disaster. Given the nagging fears of creeping climate change and the increased frequency of intense and sudden disastrous events around the world, the importance of shifting to a proactive stance, in the form of prevention and mitigation strategies for instance, is widely recognized.

By now resilience has become a word that is losing meaning through overuse, but there is still enough to discuss. Is resilience merely reactive? Can it be used in advance of disaster or massive change? Alternatively, can resilience become a tool for transformation, so the negative impacts of events are reduced even as they unfold? More interestingly, can a more mature view of resilience be used to respond simultaneously to inter-connected problems? Such an ideal would require a virtuosity that is rare, not to mention a perfect awareness of the complexities that might be impossible. It is too early to judge, but the authors collected in this book hint at the possibility of a change in that direction as we take advantage of new opportunities; including an increase in computational power, a willingness to make



connections across fields of knowledge, and a slight shift in politics towards adaptation-based solutions to the problems arising from massive change.

Looking in hindsight at the chapters of this book we would like to suggest that it is in fact time to re-imagine the meaning of resilience, and to consider the term as a single point in a constellation. The authors collected here often mention or allude to adaptation and transformation as much as to building resilience in their texts. These terms seem to be similar, but there is a distinction that we think is important to underline as it hints at possible future directions that research and practice might be taken in the face of disaster or other forms of change.

## Defining Resilience

Resilience is the capacity of a system to absorb disturbances and reorganize while undergoing change. At the end of an event the system should more or less retain its original structure and function, and therefore its identity (Folke et al. 2010).

The term resilience has a relatively long history, and its meaning has changed substantially since its first use. As an idea it was originally studied in the context of engineering, and was a term commonly reserved for discussions on the strength of materials. Adopted by ecologists in the 1970s the term began to be used to describe the amount of disturbance an ecosystem could withstand without losing its self-organized processes and structures (Holling 1973). More recently the meaning has expanded to fit the need to manage more pointed, even political, types of change. In the context of climate change for instance, resilience is defined as “*the ability of a system and its component parts to anticipate, accommodate, or recover from the effects of an event. It can do so through preservation, restoration, or improvement of its basic structures and functions*” (IPCC 2012). Others give the term an even broader meaning: “*Building resilience into human–environment systems is considered an effective way to cope with change characterized by surprises and unknowable risks*” (Tompkins and Adger 2004).

As the word resilience has grown in breadth it has simultaneously deepened. Significantly, in most current usage the ability to bounce back from a shock does not imply a simple restoration to some previous marker from the past. Instead, resilience assumes that lessons learned from a crisis are embedded in the recovery, so a community or system will be stronger than before. Lessons are not always equally applied, especially in resource-poor communities, however as a general statement we can say that a purely reactive form of resilience is rare. Pro-active elements naturally become part of almost all resilience activities. Which is to say resilience is not a pure concept. For much the same reason, as a tool for planning we should be careful to avoid using it normatively to characterise objectives, because we cannot always determine whether a particular characteristic of resilience is good or bad (Béné et al. 2012). This conception requires that any proactive activity is viewed as tentative and temporary, open to change as new information and

experience is gathered. This is a supremely objective view of the term, and as such difficult to carry out.

The notion of resilience has been used in academic literature and political policies, sometimes as a buzzword (Davoudi et al. 2012), or as a utopian ideal (Sudmeier-Rieux 2014). At the risk of muddying the waters further it is worth noting that increasing the resilience of a group is not generally speaking a neutral activity, and could easily become exploitative of the vulnerable. To avoid confusion and negative interpretations of the term, the authors offer that resilience is inseparable from the concepts of adaption and transformation.

### *Defining Adaptation*

While resilience has its origins in engineering, the term adaptation comes from evolutionary biology. In its broadest definition, adaptation refers to an action that allows a form or a structure (i.e., a household, community, group, region, or even a country) to better cope with a stressful condition. For a more nuanced understanding, consider its origin in biology, which stresses the process of modification to better fit into a changed or changing environment (Smit and Wandel 2006). In this field of study, a structure with higher adaptive capacity is thought to be more resilient, and vice versa. In the context of climate change, adaptation has a more precise meaning, and refers directly to the process of adjustment to an actual (or expected) shift in the climate in order to mitigate harm or to exploit an opportunity (IPCC 2012).

In hindsight it is surprising that the IPCC consciously focused for so many decades on mitigation to climate change while downplaying adaption. The IPCC was concerned primarily with introducing regulations or new technology in order to reduce exposure to harmful change (Nelson et al. 2007) and to reduce greenhouse gas emissions. With that goal in mind, adaptation was seen by some as a distraction. However, with major storms and other natural disasters causing ever more damage around the world, awareness of the need for adaptation (if not to climate change then at the very least to risk in general) has increased significantly. Among those who study climate change the topic has found renewed interest, and many scientists and economists now consider adaptation as a complimentary strategy to mitigation and even argue that both strategies must be pursued simultaneously (Biesbroek et al. 2009; Swart and Raes 2007; Klein et al. 2005; Martens et al. 2009). As an example of the broad effect of this change of heart, the recent IPCC report (AR5) presents climate change as one inter-connected problem among many, its characteristics determined by interaction with a mixed set of complicated and often changing problems.

Recognition of complexity in this way is a positive step, but underlines the reason adaptation was kept from the centre of climate change debate for so long. Discussing mitigation is easier because the goal is clear and the methods are relatively transparent, if difficult to achieve. Adaptation on the other hand requires

complicated solutions, where several problems are tackled at once, and the objectives and methods can be very hard to use as examples for others—because of the complexity involved they are innately difficult to copy. When seen from this point of view solving climate change becomes less about mitigation and more about managing social challenges. These can include specific issues like the rapid de-population of rural Japan, or massive migration in south-east Asia. Or they can be very broad and might include the need to develop economic equality, women's rights, or the development of a skilled global workforce. As Rob Roggema points out in Chap. 16, these are wicked problems, difficult to solve.

With such large issues on the table it is natural to imagine that adaptation must lead to fundamental change. However, that is not always the case. As an activity, adaptation has no inherent value, and depending on the context it can be either positive, negative, or even neutral in its effect (Smit et al. 2000). With that in mind, instead of being defined by change, adaptation might better be understood in terms of its relationship to time. That is, whether it is undertaken in advance of an event, or after. Harkening back to the discussion above on the definition of resilience, adaptation activities that are taken before a risk turns into a hazard is called proactive, often taking the form of disaster risk reduction. The other end of the scale is occupied by reactive adaptation, which takes place during or after an event or a disaster. This kind of adaptation often takes the form of reconstruction.

Planning for adaptation is not something that happens in the natural world. Unless humans are involved, adaptation in unmanaged natural systems is invariably reactive. Being self-aware and able to imagine different scenarios for the future does not mean that adaptation is often pro-active. To the contrary, in socio-economic systems adaptation is usually reactive or concurrent, which means they take place as events unfold (Smit et al. 2000). When adaptation is planned there are, as one might expect, more options available, which is on the face of it an important advantage. The distinction between pro-active and reactive adaptation is not always clear however. For example, evacuating people from a flood-hit area is reactive adaptation, even if it is planned for in advance. Modifying coastal zoning laws in anticipation of stronger sea surges however is proactive adaptation (Shalizi and Lecocq 2009). There is much to be said for proactive efforts because it can save both lives and property. However, to be fair it is difficult to convince people to take significant steps in advance of a disaster that has not yet taken place. The gap between a theoretical future and the reality before us is often difficult to bridge.

Reality places constraints in other ways as well. For instance, there is a danger that adaptation policy will be used only to preserve the prevailing economic system, even when that is a less effective choice. Theoretically, adaptation can just as easily be used to foster new kinds of development or to increase access to opportunity, but that kind of change might challenge those who benefit from an existing system, and so it becomes difficult to shift. Pelling argues that when it comes to adaptation governing bodies are seldom allowed to incorporate the interests of future generations, of non-human entities, and especially their own marginalized communities (Pelling 2011). This is perhaps an old trope, but in the face of climate change the issues are more pressing than ever, and the impact will be felt as much by the

privileged as by marginalized populations. The problem is, as always, that inertia is difficult to overcome and the future is not perfectly clear, and planning in some way dependent on conjecture. Yet in a complex system, which is what most of us live in today, transformative actions are increasingly needed. Overcoming the inertia of the status quo is one of the largest hurdles that needs to be overcome in order to meaningfully adapt to change.

## ***Transformation***

According to Park and his colleagues, Transformational adaptation is “...*a discrete process that fundamentally (but not necessarily irreversibly) results in change in the biophysical, social, or economic components of a system from one form, function or location (state) to another, thereby enhancing the capacity for desired values to be achieved given perceived or real changes in the present or future environment*” (IPCC 2012; Park et al. 2012). The capacity to change a part of a system is called transformability. In other words, it is “...*the capacity to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable*” (Walker et al. 2004). In comparison with adaptation, the term “transformation” is presumed to be proactive and progressive. It also presumes some degree of feedback, as complex patterns of change take place at the personal, cultural and institutional level.

The critical issue in transformation is the so-called tipping point, or threshold. When transformability is high the range of options in the face of change is broadened. To give an example, instead of weathering a crisis, a system can sometimes reach a tipping point where its internal structure lies on the brink of collapse without actually failing (Manson 2001). In just that instance a crisis can become “*a moment of transformation—a moment in which it is recognized that a decisive intervention can, and indeed must, be made*” (Hay 1999).

If there is capacity for change then transformation becomes possible. In that case disaster can be viewed as an event where the system has passed its tipping point. Without losing sight of the pain and personal costs that disaster entails, it can also be a window of opportunity for positive transformation as recovery and reconstruction takes place. To take advantage of that moment is, again, a matter of overcoming inertia. As Christopher Field and his colleagues point out, “*transformational responses are not only possible, but they can be facilitated through learning processes, especially reflexive learning that explores blind spots in current thinking and approaches to disaster risk management and climate change adaptation*” (IPCC 2012). They elaborate on this idea by pointing out that “*because there are risks and barriers, transformation also calls for leadership—not only from authority figures who hold positions and power but also from individuals and groups who are able to connect present-day actions with their values, and with a collective vision for a sustainable and resilient future*” (IPCC 2012). The kind of leadership they imagine is defined by a willingness to accept risks and to take on burdens in order to achieve

worthwhile goals. Finding those leaders in the absence of a crisis is the challenge, and the heart of the matter. How do we encourage transformational leadership without the incentive of danger or a powerful crisis? Is there a tipping point that we might search out, or perhaps an approach that is persuasive in other ways, be it economic or cultural, which can set things in motion?

### *Going Beyond Resilience—The Transition from Resilience to Transformation*

The meaning of resilience with regards to change can be difficult to pin down. It is not always clear if the term is intended to mean resistance, adaptation or transformation. In response to this issue, Folke et al. (2010) developed a theoretical framework that they labelled Resilience Thinking, which aims at understanding the drivers of social-ecological systems (Walker and Salt 2006; Folke et al. 2010). In their conception, resilience is best described as the “*dynamics between periods of abrupt and gradual change and the capacity to adapt and transform for persistence*” (Folke et al. 2010).

By contrast, Mark Pelling offers a more critical approach. He says that resilience is a subset of adaptation. In his framework, adaptation takes three forms, namely resilience (maintaining the status quo), transition (incremental change) and transformation (radical change). When adaptation is undertaken through resilience it is working at its “*most contained level*”. Interestingly, for Pelling resilience is a negative term, designed only to preserve existing power structures and social systems (the implication is that such preservation is at the cost of others not in power). Adaptation through transition offers a better way forward but is still imperfect. He suggests that when adaptation assumes that form then critical engagement with governance plays a larger role, but is limited to the simple assertion of “*rights and responsibilities*” without changing the actual power regime. His final category, of transformation, is clearly preferred in his view, and is accordingly defined as “*reform in over-arching political-economy regimes and associated cultural discourses on development, security and risk*” (Pelling 2011). This three-part framework is conceptually clear and useful, but in practical terms it is also simplistic because it does not recognize the complexity of issues at different scales. It also fails to acknowledge that each scale might require “*separate or integrated levels of resilience*” (Béné et al. 2012). In this light the term resilience should perhaps not be applied so liberally to discussions of adaptation in the face of disaster or other kinds of massive change.

Christophe Béné et al. (2012) offer a more flexible vision of resilience. Responding to previous work by Guhan (1994), Béné and his colleagues propose that resilience has different characteristics depending on the impact of the disturbance. In other words, the meaning of the word is itself not fixed. To the contrary they suggest that “*managing...resilience requires directing a system in a way that promotes **resistance** in a period of small disturbance, **adaptation** in a time of*

**Table 1.1** Conceptual framework of resilience, adaptation, and transformation

Articles	Coping	Adjusting	Transforming
Climate Adaptation (Pelling 2011)	Resilience	Transition	Transformation
Adaptedness (Nelson et al. 2007)	Resilience	Incremental	Transformative
Resilience Thinking (Folke et al. 2010; Walker and Salt 2006)	Resilience	Adaptivity	Transformability
Resilience (Martin-breen and Anderies 2011)	Engineering resilience	Systems Engineering	Complex systems
Morphogenetic Cycle through lens of reflexivity (Davidson 2012)	Structural conditioning	Social-cultural interaction	Structural elaboration (Morphogenesis)
3P&T-3D Analytic Framework (Béné et al. 2012) (Objective/outcome)	Absorptive capacity (Persistence)	Adaptive capacity (Incremental adjustment)	Transformative capacity (Transformational response)

greater disturbance, and **transformability** when conditions are becoming unviable or unsustainable” (Emphasis added, Béné et al. 2012). The salient point is that resilience emerges from each kind of activity, and each leads to different outcomes. Béné also raises the important question of cost. Although he is unable to claim any certainty, his assumption is that transformation has a higher cost and a higher risk than simple resilience. In his words, “[It] costs more to transform a system than to maintain it as it is or to rebuild it as it was” (Béné et al. 2012). This is a very important point that underlines the difficulty of overcoming inertia when faced with change, even if there is a crisis forcing action.

Table 1.1 gathers a selection of theoretical frameworks created to understand resilience, adaptation, and transformation, and describes the attributes of each author’s conception of these terms when applied to the real world. They all share a theoretical basis in complex systems to some degree, and are all useful in that they offer a point of view that easily accommodates both slow and rapid instances of change. On the other hand, all of the frameworks share the same weakness, namely that the boundaries and factors of a system are not so easily defined in a period of genuine uncertainty and emergent complexity. Overcoming that limitation requires a new approach.

## Rethinking Resilience

### *Awareness of Vulnerability*

Resilience reduces the vulnerability of a system, and increases the capacity to absorb and adapt to surprises. But what is vulnerability? According to Miller “...

*resilience and vulnerability are potentially complementary, in the sense that actor-based vulnerability analyses look at the processes of negotiation, decision-making, and action, whereas systems-based resilience analyses complement this approach by examining the interaction of social and ecological processes”* (Miller et al. 2010). It is important to recognize that resilience and vulnerability are not opposite terms. As ideas they represent two ways to understand the response of systems and/or actors to shocks and surprises.

The term vulnerability is open to sub-division. For example, exposure to hazards can be thought of as a kind of “physical vulnerability”, defined by the potential damage to a system that could come from a disaster (Brooks 2003). Vulnerability that is embedded in a system because of its internal characteristics is called “Inherent Vulnerability”; it is sensitive to geographical, geological, and ecological conditions. Finally, according to Adger, “Social Vulnerability” is defined as the potential exposure of groups or individuals to stress as a result of disaster (Adger 1999).

It is useful to look deeper into these terms. For instance, physical vulnerability can be understood as a function of the frequency and severity of a hazard; that is, a hazard causes no damage if it occurs in an unpopulated area or in a region where human systems are adapted to cope with it. Social vulnerability on the other hand is more complex. As an example, the quality of housing is an important determinant of a community’s social vulnerability to a flood or a windstorm, but has less impact on vulnerability in the case of a 20-year drought (see for instance Amir in Chap. 9). In the same way, poverty, inequality, health, access to resources and social status can determine the vulnerability of communities and individuals with relation to a very broad range of hazards (Brooks 2003). In most cases, vulnerability combines both physical and social aspects. Separating them can be a challenge.

Although resilience differs from vulnerability in its framing and its scale, the starting point is similar. Both look at how social groups or communities are exposed to shocks and stressors and how they differ in terms of their sensitivity and coping capacity. Both also emphasize the influence of spatial, physical, and social characteristics. What is often neglected in vulnerability research is the interaction between long term and short term ecological and biophysical changes. That is, researchers predominantly focus on the response to hazards or shocks, rather than on longer-term adjustments and changes. Adaptation measures, for instance, often fail to address persistent and intractable vulnerabilities, thus undermining their success and their sustainability (Nelson et al. 2007). The study of resilience on the other hand offers a framework for dealing with the long term, and as such is an essential starting point for the examination of vulnerability as well.

As a theory the issue may seem academic. However, there are real consequences that lend weight to this point. After the tsunami disaster struck Aceh in 2004, the government, along with academia, and social agencies began developing concepts and approaches to improve the resilience of communities facing environmental risk in coastal zones. However, an over-emphasis on tsunamis as the single most important source of disaster on the coast led, in some cases, to a failure to anticipate other risks and disasters from natural change. After some time, it became clear that



other kinds of environmental change, even anthropogenic behaviour or man-made hazards should be prepared for as well (see Alamsayah's discussion on this point in Chap. 8).

Increased awareness of vulnerability often is followed by improved attention to climate change, especially as policies and practices are followed through in both developed and developing countries (see Chap. 11, and the role of business development in response to vulnerability, according to Hiramoto). That said, it is significant that, while adaptation activities were once dealt with as single incidents, it is now more common to see each activity in the context of a larger holistic plan. The creation of National Adaptation Plans (NAPs) around the world are a key outcome of that trend in terms of policy, although it is too soon yet to know how much impact they will have.

### *Embracing Change, or Resilience Thinking*

Change in modern society can be described diagrammatically as the result of feedback between stressors. The difficulty is that while such a simplistic observation can be easily made, it is hard to recognize and identify either the feedback, or the stressors. Complicating the issue further, recognition does not translate into understanding, especially when the issues at hand are complex or political. The very complexity of climate change presents a particular example for policy makers and resource managers because the available science is often uncertain (Scarlett 2010; Berkes et al. 2003). We are familiar with rapid onset events such as earthquakes, droughts, floods, and even an economic crisis. Those events are the final eruption after the accumulation of slowly building stress and only become apparent when the gradual change passes a certain threshold. As mentioned previously, a threshold is a tipping point when a system flips from one state to another. However, neither nature nor humanity are linear and predictable. We seldom know when and where the thresholds are to be found or even what they look like. A threshold can be physical, or it could be formed by a group or a particular sector within society (Ionescu et al. 2009). Theoretically if we are aware of the existence of an important threshold we will be able to act (reactively or pro-actively) and postpone or prevent a collapse. The problem is that the time scale of both natural and political processes are difficult to perceive (Streets and Glantz 2000). Coping with the slow pace of this kind of change necessitates that we learn to understand both slow and rapid onset events synthetically so we can not only adapt to change, but also take advantage of change as it happens. Unfortunately, the long-term view of large areas is not easy to maintain when local short-term problems are so immediate and apparently powerful. With this in mind, Resilience Thinking provides a framework for embracing change and disturbance rather than denying or constraining it (Walker and Salt 2006). It is built on the theory of complex systems, where self-organization is described as part of an adaptive cycle.



The adaptive cycle describes the way a social and ecological system behaves over time as it moves through cyclic patterns of growth and conservation (called the fore loop) followed by release and renewal (called the back loop). The so-called fore loop is characterized by the rapid accumulation of capital and potential in a stable and conservative context. In contrast the back loop is characterized by slow change combined with uncertainty. These cycles are in motion at the same time, a perfect representation of the dichotomy of complex systems. What this means is that a complex system may be growing and appear robust however there is at the same time some amount of slow and accumulating change that could suddenly and drastically transform the system, like a continuous conveyer belt that moves at different speeds within its length. A catalysing event can shift a system rapidly from the fore loop to the back loop, which can be destructive. Ironically it is just at this time that creative (or destructive) transformational actions can be most easily introduced.

Collectively speaking, most of our research and nearly all of our management and policy development is focused on fore loop behaviour. We know little about complex systems in their brief and chaotic, but very critical back loop periods (Walker and Salt 2006). It is important that we learn more. When a feedback loop begins breaking rigid connections and behaviours, new opportunities open up and new resources are made available for growth.

Taking advantage of that point in time is not easy. It was once thought that reconstruction after the Tohoku disaster in Japan in March 2011 would induce change in the fundamental social and economic systems of Japan, but it is hard to conclude yet whether transformational change has begun or if it is even possible. Still it is interesting that for many people the final evaluation of the crisis will not be made with regards to how well Japan restored its coastline communities. Instead the focus is on how well Japan managed to develop systems and institutions that will allow the nation to revitalize the country on a continuous basis (see Dimmer's discussion in this point in Chap. 2). Delving deeper into the problem, in the case of Japan the Tohoku disaster was massive, and undeniably destructive. However, there was already another massive but slow process of change underway that could just as easily be as damaging, and which will almost certainly bring about unexpected kinds of change across the country. Specifically, Japan has crossed the tipping point into a period of rapid population decline that is as yet only tentatively being addressed. Curiously the Japanese government and academics have known for years that there was a crisis coming, but did not act to slow it down (to be fair, it is possible that no action could have made a difference). This is perhaps a perfect example of how hard it can be to manage slow change, even when it is well understood. Ideally, Japan would take advantage of the crisis caused by the Tohoku disaster to also respond to their population crisis. Similarly, it is possible still that Japan will reduce its reliance on fossil fuels in the long term as it finds way to manage the loss of energy production from nuclear power. Without the nuclear disaster at Fukushima, described with some detail by Uehara in Chap. 18, it is unlikely that such a change would have become a possibility in Japan. Time will tell

which direction the country will eventually take on these essential issues for its future.

## ***Sustainability***

Since the concept of sustainable development was proposed in the 1970s our knowledge about the limits of natural resources and the importance of diversity has been magnificently improved. Sustainability is the capacity to create, test, and maintain adaptive capability (Holling 2001). It depends on building and maintaining the adaptive capacity needed to deal with the shocks, surprises and longer term structural transformations that are increasingly common in our world. On the other hand development is the process of creating, testing, and maintaining opportunity. It is a “*continuous process of adaptation and accommodation between individuals and their environments*” (Waller 2001).

Resilience Thinking shares many concepts of sustainable development. Walker and Salt tell us that a “*resilient social-ecological system in a ‘desirable’ state has a greater capacity to continue providing us with the goods and services that support our quality of life while being subjected to a variety of shocks*” (Walker and Salt 2006, p. 32; Pisano 2012). Similarly, resilient social-ecological systems are able to absorb larger shocks without changing in a fundamental way. If massive transformation is inevitable, resilient systems contain the components needed for renewal and reorganization (Folke et al. 2002). In other words, a resilient system can cope, adapt, and reorganize without sacrificing the important contribution of ecosystem services (Folke et al. 2010).

This coincidence of concepts is not presented as a substitution for sustainable development. It is introduced as a conceptual model that might help us to understand how to actually make change sustainable in practice. We are now, it is suggested, feeling the consequences of a shift from simple modernity to something new, which Beck calls a period of reflexive modernity. This is a global phenomenon to varying degrees, sometimes also called the ‘post-growth’ economy. At the risk of over simplifying, a sustainable society must first be a resilient society. As Jordan points out in his overview of the problems facing the African continent, there is a compelling need for a more equal distribution of economic security and well-being. While that is a topic beyond the scope of this book, the idea is touched upon in many of the chapters. Responding to social and economic issues as well as the more obvious material needs that come with disaster or sudden change is important. It may be that we can learn lessons from those who are engaged in sustainable development as we try to respond or plan for resilience in the face of massive change.

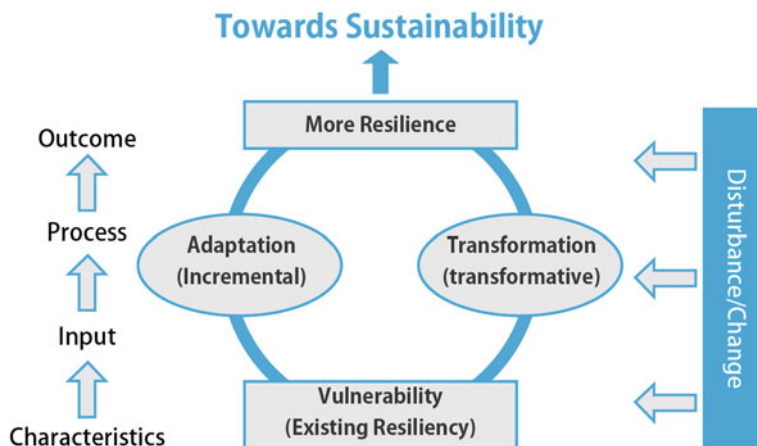
## ***Reframing Resilience***

Vulnerability, resilience, adaptability and transformability are important concepts that can be used to describe a complex system. Despite a wide range of discussion concerning each one on its own in the literature, a clear description of how they are integrated is rare (Lei et al. 2013). Based on the material outlined above we propose to organize these key concepts of resilience thinking as in Fig. 1.1. In this diagram vulnerability and resilience are seen as the input and output of a system as it moves towards a more sustainable form. Adaption and Transformation are the processes by which change is responded to. They are not mutually exclusive from each other but can take place simultaneously and at several scales. In this way Resilience Thinking follows the adaptive cycle and the rules of panarchy.

Vulnerability is a core concept in disaster risk management. Although the concept has long been incorporated into practice in development, food security, and disaster risk communities, there are few examples that document how resilience is explicitly incorporated. In most cases resilience and vulnerability are potentially complementary, in the sense that actor-based vulnerability analyses look at the processes of negotiation, decision-making, and action, whereas systems-based resilience analyses take a similar approach by examining the interaction of social and ecological processes (Miller et al. 2010). That said, vulnerability researchers predominantly focus on the response to hazards or shocks, rather than on longer-term adjustments and changes. The interaction between long and short term ecological and biophysical changes is often overlooked.

Adaptive capacity (or adaptability) refers to the capacity of a particular system to cope with shocks (Gunderson 2013). Given that the term is used in the context of a specific system it is implicitly focused on smaller time scales. Longer time scales become apparent when looking at the capacity to transform. Transformability is the ability of a part of a complex adaptive system to assume a new function (Martin-breen and Anderies 2011). It is most relevant over larger time scales, and can be understood as the ability of a system to change its identity.

The four concepts can also be understood to mirror the phases of the adaptive cycle. That is, they are all equally important, and highly interconnected. On the surface one aspect may appear to be dominant, as when there is a regime change, or a period of stability, however the reality is that there is a basic state of constant movement if not outright change (Walker and Salt 2006). The concept of panarchy is particularly useful to understand this statement because it assumes a relationship between activities taking place at different scales. In this world view transformational change at the small scale makes stability or resilience possible at the large scale, and vice versa. The capacity to undertake change at the smaller scale draws on the capacity for resilience at other scales. It is because of this relationship that a crisis can become an opportunity for innovation and for the implementation of novel ideas. Experience and knowledge can be re-combined to navigate periods of social–ecological transition (Folke et al. 2010). With this in mind, the application of resilience thinking depends on our perception of the scale, or the boundaries, of a



**Fig. 1** The relationship between vulnerability, resilience, adaptation, and transformation is best understood according to the rules of panarchy

system. To give an example, in our highly globalized and urban world, people tend to migrate to cities in response to climate extremes. Chulun gives us the example of herders in Mongolia moving to the city as they escape the climate disaster known as Dzug (see Chap. 6). Over time the density of agglomeration overwhelms the existing urban form, and short circuits the adaptive cycle, resulting in structural transformation of the economy at the individual, regional and national level.

## Rethinking Change Through the Lens of Resilience

Although substantial discussions in research literature provides more than enough information to develop a theoretical framework of resilience, there are few documented cases for how the various theories are adopted and applied by managers, community leaders, and policy makers (Miller et al. 2010). Nonetheless the practice of resilience is ubiquitous around the world, whether it is undertaken with any knowledge of the theories outlined above or not. Several of the articles in this book make this point clear. That is not to say the framework outlined above is only useful as an academic exercise. Resilience can be improved, and better planned for, by involving the complexities of the adaptive cycle and by acknowledging the complexities of panarchy. Especially with this point in mind we would like to suggest that change and crises are important opportunities that can be taken advantage of to improve social and economic conditions for everyone. The examples in this book were selected specially to highlight this potential.

The theory of resilience places change within a dynamic system in order to understand its ability to absorb, adapt, and transform. Within the adaptation cycle (which follows a cycle of growth, followed by conservation and then re-organization) resilience and vulnerability are essential characteristics that can be found throughout the pattern. In a similar way, while it is a slight simplification, adaptation can be understood as the path taken by a community or a group as they transform a point of vulnerability to a point of resilience.

Epistemologically, resilience is a bridge to sustainability on several scales. It provides a lens for the examination of change in a systematic way around the world. Under this lens, change is normal. Under this lens, the collective tendency of complex systems is mostly seen as a positive thing. However, complexity can also be fragile and difficult to manage. The more complex a system, the more likely we are to be surprised by an unanticipated point of failure. It is clear that we will never be able to prepare for every hazard, and so it seems better to aim for flexibility instead. In theory that is the logical conclusion. Yet, in reality the first role of resilience is to resist change. In this regard the “precautionary principle” (which can be summarize with the aphorisms of “do no harm”, or “look before you leap”) provides a pragmatic political option for dealing with uncertainty, risk and vulnerability, and it is much easier to realize because the boundaries are clear. It is a useful tool, in fact, because it is so pragmatic. Yet it is nonetheless essential that we do not limit ourselves to organizations that only allow this approach and as a result are designed to inhibit the mobilization of knowledge and resources that might lead to more diverse and flexible strategies for managing change. The precautionary principle is applied when we do not have sufficient knowledge at hand. Our hope is that we will begin to know more about managing change and its consequences and thus become more pro-active and increase the benefit of policies for all. The precautionary principle is not sufficient to the challenge.

Crises and disasters provide opportunities to collectively and reflectively embark upon incremental adaptation and structural transformation. As Pelling has said, climate change and the crisis of capitalism is a chance to reclaim self, society and nature (Pelling 2012). However, disasters and reconstruction do not automatically invoke proactive activities. To the contrary, transformative change often challenges the status quo, threatening those who benefit from the current systems and structures. As a result, it is particularly hard to begin, never mind to see through, real change. In this way transformation to a resilient society is unlikely to be achieved through political power. It may be more likely realized through an iterative process of learning within communities.

Community has the potential to play an important role in the reorganization of natural and social resources. The high potential of social capital and the opportunity for every stakeholder to join in the process are the most important characteristics of a community-based approach to developing flexibility. In this regard so-called reflexive learning supports learning through social practice as it responds to failed development projects and programmes. To be successful it requires the transformation from the simple modernity of industrialization to “...a reflexive second modernity that not only changes social structures but also revolutionizes the very

*coordinates, categories and conceptions of change itself*" (Beck 1992). This is very appealing and yet it is not clear how this might be used to balance resilience between all of the layers of a stratified society.

We live in a time where change appears infinite but our knowledge is limited. Continual surprise from disasters and crises is becoming a normal state. The question to answer is how to act within that context. Resilience is simultaneously a theory about change, a methodology to manage change, and a mind-set about how to live with change. It can be used as a tool for precaution, adaptation and transformation, and is neutral enough to fit into a collaborative process that brings together divergent groups facing strident differences. The potential is quite clear, and yet its use as a tool in practice is not yet well resolved. This book sets out to give a snapshot of how change is being managed, offers some lessons in the form of case studies, and suggests ways to move forward from the current situation.

The material covers a breadth of topics, but is grounded by the shared point of view of active practitioners. To give a structure to the chapters we have grouped them into five sections. Part one looks at how to recognize vulnerability; part two considers the challenge of preparing for change; part three introduces some of the tools that we can use to build resiliency; part four considers the potential of using change as an opportunity to build better places and institutions; finally, part five focuses on the very important role of community in building resilience. Taken together the text forms a useful outline for understanding where we might go next.

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