

[bnhcrc.com.au](http://bnhcrc.com.au)

# TECHNICAL PAPER TRANSLATING RESILIENCE THEORIES INTO DISASTER MANAGEMENT POLICIES

**Disaster resilience definitions and case study narratives**

**Caroline Wenger**

The Australian National University  
Bushfire and Natural Hazards CRC





| Version | Release history             | Date       |
|---------|-----------------------------|------------|
| 1.0     | Initial release of document | 22/05/2017 |



**Australian Government**  
**Department of Industry,  
 Innovation and Science**

**Business**  
 Cooperative Research  
 Centres Programme

This work is licensed under a Creative Commons Attribution-Non Commercial 4.0 International Licence.



**Disclaimer:**

The Australian National University and the Bushfire and Natural Hazards CRC advise that the information contained in this publication comprises general statements based on scientific research. The reader is advised and needs to be aware that such information may be incomplete or unable to be used in any specific situation. No reliance or actions must therefore be made on that information without seeking prior expert professional, scientific and technical advice. To the extent permitted by law, The Australian National University and the Bushfire and Natural Hazards CRC (including its employees and consultants) exclude all liability to any person for any consequences, including but not limited to all losses, damages, costs, expenses and any other compensation, arising directly or indirectly from using this publication (in part or in whole) and any information or material contained in it.

**Publisher:**

Bushfire and Natural Hazards CRC

May 2017

Citation: Wenger C (2017) Technical paper: Translating resilience theories into disaster management policies, Bushfire and Natural Hazards CRC

Cover: Long-term strategies are needed for resilience to floods. Credit: iStock

# TABLE OF CONTENTS

|   |    |
|---|----|
| <b>Introduction</b> .....   | 3  |
| <b>Deciphering resilience definitions</b> .....   | 4  |
| <b>Disaster resilience definitions found in policy and report documents</b> .....   | 4  |
| <b>Deciphering resilience definitions</b> .....   | 8  |
| <b>Resistance language in text</b> .....  | 10 |
| <b>Discussion on the use of resilience definitions</b> .....  | 10 |
| <i>Global</i> .....   | 10 |
| <i>USA</i> .....  | 11 |
| <i>UK</i> .....   | 11 |
| <i>China and The Netherlands</i> .....  | 11 |
| <i>Australia</i> .....  | 11 |
| <b>Case study narratives of disaster resilience interpretations in China, Netherlands, USA, Australia and international organisations</b> ..... | 12 |
| <b>China</b> .....  | 12 |
| <b>The Netherlands</b> .....  | 13 |
| <b>USA</b> .....  | 14 |
| <b>Australia</b> .....  | 15 |
| <b>International organisations</b> .....  | 16 |
| <b>‘Oak and Reed’ tales</b> .....   | 18 |
| <b>Aesop’s fables</b> .....   | 18 |
| <b>A selection of ‘Oak and Reed’ tales across time and between cultures</b> .....   | 18 |
| <b>LITERATURE CITED</b> .....   | 21 |

## Introduction

Caroline Wenger, Fenner School of Environment and Society, The Australian National University, ACT

This report provides supplementary information relating to research published in:

Wenger, C. (*forthcoming*). 'The oak or the reed: translating resilience theories into disaster management policies'. *Ecology and Society*.

In the context of flooding, research aimed to identify how disaster resilience was interpreted in four countries (China, USA, Netherlands, Australia) and by international organisations. To do this, it assessed the types of activities supported by disaster resilience policies. A particular concern was the use of *resistance* versus *accommodation* strategies, the former characterised by structural engineering approaches such as levees to exclude floodwaters, while the latter uses a number of approaches to enable people to live with flooding, such as ecosystem-based approaches and preparedness. Debates about the merits of these two approaches are reminiscent of the ancient Greek fable, 'The oak and the reed' by Aesop (hence the paper's title).

Many theorists feel that resistance strategies undermine long-term resilience and are ultimately maladaptive, for reasons such as: (1) the encouragement of development in hazardous places, increasing potential damages; (2) long term geophysical changes such as sediment starvation that increase flood magnitude; (3) reduced opportunities for learning from small events; (4) regression of building standards; (5) floods transferred to other communities or social groups; (6) degradation of natural resources on which societies depend (Smith 1998, Adger et al. 2005, Burby 2006, Hudson et al 2008, Tockner 2008, Liao 2012).

Despite these drawbacks, resilience policies commonly support resistance measures. Research investigated the reasons for this, including various resilience theories (engineering, ecological, social-ecological systems), and how they interlink with maintaining the status quo, adaptation (incremental, transformation) and pre-existing disaster management frameworks, in particular the Prevent-Prepare-Respond-Recover Framework (PPRR). It was found that generally, any PPRR activity could be said to contribute to 'increased resilience' and that more discrimination between measures was needed to ensure outcomes were adaptive over the longer term (Wenger, *forthcoming*).

Research methodology combined quantitative and qualitative methods. For quantitative work, policy documents and reports (covering flood management, disaster resilience and climate change) were selected from each case study area (105 documents in total). Activities that were linked to improved resilience were entered into a revised PPRR framework to determine how resilience was interpreted for each case study area (Wenger, *forthcoming*).

To complement this, qualitative work was also undertaken. Where documents provided a disaster resilience definition, it was documented and analysed. Case study narratives were also prepared. Results of qualitative findings are summarised in Wenger (*forthcoming*). In this report, additional detail is provided for readers wishing to know more about this aspect of the work. It is divided into the following sections:

1. Deciphering resilience definitions
2. Case study narratives of disaster resilience interpretations
3. 'Oak and Reed' tales

## Deciphering resilience definitions

### Disaster resilience definitions found in policy and report documents

Words and phrases are coded using colours which are explained in the section ‘deciphering resilience definitions’, below. Coding is intended to help rapidly determine which definitional element is in each resilience definition.

#### Global

|  |                                    |
|--|------------------------------------|
| The capacity of a system, community or society potentially exposed to hazards to <b>adapt</b> , by <b>resisting</b> or <b>changing</b> in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of <b>organising itself</b> to increase this <b>capacity for learning from past disasters for better</b> future <b>protection</b> and <b>to improve risk reduction</b> measures.* | UNISDR 2005                        |
| The ability of a system, community or society exposed to hazards to <b>resist, absorb, accommodate to</b> and <b>recover</b> from the effects of a hazard in a <b>timely and efficient</b> manner, including through the <b>preservation</b> and <b>restoration</b> of its essential basic structures and functions.   | UNISDR 2009                        |
| The ability of a system and its component parts to <b>anticipate, absorb, accommodate, or recover</b> from the effects of a hazardous event in a <b>timely and efficient</b> manner, including through ensuring the <b>preservation, restoration, or improvement</b> of its essential basic structures and functions.  | IPCC 2012;<br>WB and GFDRR<br>2013 |
| The capacity of social, economic, and environmental systems to <b>cope</b> with a hazardous event or trend or disturbance, <b>responding</b> or <b>reorganizing</b> in ways that <b>maintain their essential function, identity, and structure</b> , while also maintaining the capacity for <b>adaptation, learning, and transformation</b> .   | IPCC 2014                          |
| The capacity of a system to <b>absorb</b> disturbance and <b>reorganize</b> while <b>undergoing change</b> so as to <b>retain essentially the same function, structure, identity and feedbacks</b> .   | GEF 2015                           |
| The capacity that people or groups may possess to <b>withstand</b> or <b>recover</b> from emergencies and which can stand as a counterbalance to vulnerability   | Jha et al. 2012†                   |

\* This definition was adopted by the US National Science and Technology Council’s Subcommittee on Disaster Reduction (SDR, 2005, p.17).

† A World Bank publication.

#### USA

|   |                                  |
|---|----------------------------------|
| The ability of social units (e.g., organizations, communities) to mitigate risk and <b>contain the effects</b> of disasters, and carry out <b>recovery</b> activities in ways that minimize social disruption while also minimizing the effects of future disasters.<br><br>Disaster Resilience may be characterized by <i>reduced failure probabilities</i> (i.e. the reduced likelihood of damage to and failure of critical infrastructure, systems, and components); <i>reduced consequences from failures</i> (in terms of injuries, lives lost, damage, and negative economic and social impacts); and <b>reduced time to recovery</b> (time required to <b>restore</b> a specific system or set of systems to normal or pre-disaster levels of functionality). | MCEER 2006;<br>NIST 2008:47      |
| The capability of an asset, system, or network to <b>maintain its function</b> or <b>recover</b> from a terrorist attack or any other incident.   | DHS 2006                         |
| The ability to <b>resist, absorb, recover</b> from, or successfully <b>adapt</b> to adversity or a change in conditions.  | DHS 2009                         |
| 1. ability to <b>adapt</b> to changing conditions and <b>prepare</b> for, <b>withstand</b> , and <b>rapidly recover</b> from disruption<br>2. ability of systems, infrastructures, government, business, communities, and individuals to <b>resist, tolerate, absorb, recover</b> from, <b>prepare</b> for, or <b>adapt</b> to an adverse occurrence that causes harm, destruction, or loss   | DHS 2010;<br>White House<br>2010 |
| the ability to <b>withstand</b> naturally variable conditions and/or <b>recover</b> from disturbances   | CPRA 2012                        |

|  |   |
|--|---|
| The ability to <b>adapt</b> to changing conditions and <b>withstand</b> and <b>rapidly recover</b> from disruption due to emergencies.   | White House 2011; DHS 2011; HSRTF 2013:37; FEMA 2015a; FEMA 2015b |
| 1. Able to <b>bounce back</b> after change or adversity.<br>2. Capable of <b>preparing</b> for, <b>responding</b> to, and <b>recovering</b> from difficult conditions.<br>Syn.: TOUGH See also: New York City  | CNY 2013  |
| the ability to <b>anticipate</b> , <b>prepare</b> for, <b>respond</b> to, and <b>adapt</b> to changing conditions and to <b>withstand</b> and <b>recover rapidly</b> from disruptions with minimal damage  | USACE 2013  |
| The ability to <b>anticipate</b> , <b>prepare</b> for, and <b>adapt</b> to changing conditions and <b>withstand</b> , <b>respond</b> to, and <b>recover rapidly</b> from disruptions.  | HSRTF 2013:169; White House 2013a; White House 2014               |
| The ability to <b>prepare</b> for and <b>adapt</b> to changing conditions and <b>withstand</b> and <b>recover rapidly</b> from disruptions. Resilience includes the ability to <b>withstand</b> and <b>recover</b> from deliberate attacks, accidents, or naturally occurring threats or incidents.  | White House 2013b; DHS 2013                                       |
| 1. the ability to <b>withstand</b> and <b>recover</b> from both natural and man-made hazards [p.6]<br>2. the capability of systems to <b>prevent</b> or <b>protect</b> against significant multihazard threats and the ability to <b>recover rapidly</b> and ensure continuity of critical services, with minimal negative impact to public health and safety [infrastructure resilience] [p.149]  | ASCE 2009   |
| capability to <b>prevent</b> or <b>protect</b> against significant multihazard threats and incidents and the ability to <b>expeditiously recover and reconstitute</b> critical services with minimum damage to public safety and health, the economy, and national security [infrastructure resilience]  | ASCE 2013   |
| A disaster-resilient nation is one in which its communities, through <b>mitigation and pre-disaster preparation</b> , develop the <b>adaptive capacity</b> to maintain important community functions and <b>recover quickly</b> when major disasters occur.  | NRC 2011  |
| 1. ability of a system to <b>absorb</b> disturbance and <b>quickly return to normal or a new normal</b> while maintaining its identity and ability to function [p.ix]<br>2. the ability of a system to <b>absorb</b> change and disturbance while maintaining its basic structure and function [p.4]<br>3. the capacity of a system to <b>absorb</b> change and disturbances, and still retain its basic structure and function—its identity [p.28]  | NRC 2012a   |
| The ability to prepare and plan for, <b>absorb</b> , recover from, and more successfully <b>adapt</b> to adverse events*   | NRC 2012b   |
| 1. The ability to <b>prepare and plan</b> for, <b>absorb</b> , <b>recover</b> from, and more successfully <b>adapt</b> to disasters [preface]<br>2. The ability to prepare and plan for, <b>absorb</b> , <b>recover</b> from, and more successfully <b>adapt</b> to actual or potential adverse events....the ability of individuals, communities, localities, states, regions, and the nation to <b>respond</b> and <b>recover</b> in a manner that minimises disaster life and property losses and enables <b>rapid return</b> of normal economic and other life activities in the wake of disasters [p.7] | GAO 2015  |
| 1. the ability to <b>become strong, healthy, or successful again</b> after something bad happens<br>2. the ability of something to <b>return to its original shape</b> after it has been pulled, stretched, pressed, bent, etc.  | Merriam-Webster Dictionary 2016                                   |

\* A report commissioned by eight US government agencies including FEMA, USACE and the Department of Homeland Security.

## UK

|  |                                |
|--|--------------------------------|
| Resilience measures aim to reduce the consequence of flooding by, for example, facilitating <b>the early recovery</b> of buildings, infrastructure or other vulnerable sites following a flooding event or by ensuring that key infrastructure such as power distribution centres, telecommunication control centres and key emergency access routes have enhanced levels of <b>protection</b> or other <b>mitigation</b> measures.  | DEFRA 2005                     |
| Ability of the community, services, area or infrastructure to detect, <b>prevent, and, if necessary to withstand, handle and recover</b> from disruptive challenges  | Cabinet Office 2013            |
| Provide resilience for the UK by being <b>prepared</b> for all kinds of emergencies, able to <b>recover</b> from shocks and to maintain essential services.  | HM Government 2010             |
| The capacity of an individual, community or system to <b>adapt</b> in order to <b>sustain an acceptable level of function, structure, and identity</b> .   | Cabinet Office 2011            |
| The ability of a system or organisation to <b>withstand</b> and <b>recover</b> from adversity [p. 240] the ability of the community, services, area or infrastructure to <b>withstand</b> the consequences of an incident [p. 461]   | Pitt 2008                      |
| <p>I. Literal applications.</p> <ol style="list-style-type: none"> <li>1. The action or an act of <b>rebouncing or springing back; rebound, recoil</b>. <i>Obs.</i></li> <li>2a. Elasticity; the power of <b>resuming</b> an original shape or position after compression, bending, etc.</li> <li>2b. <i>Mech.</i> The energy per unit volume <b>absorbed</b> by a material when it is subjected to strain; the value of this at the elastic limit.</li> </ol> <p>II. Figurative uses.</p> <ol style="list-style-type: none"> <li>3. The action of <b>going back</b> upon one's word. Cf. resilement n. <i>Obs. rare</i></li> <li>4a. The action of revolting or <b>recoiling</b> from something; an instance of this. Now <i>rare</i>.</li> <li>4b. Repugnance, antagonism. <i>Obs. rare</i>.</li> <li>5. The quality or fact of being able to <b>recover quickly</b> or easily from, or <b>resist</b> being affected by, a misfortune, shock, illness, etc.; robustness; <b>adaptability</b>.</li> </ol> | Oxford English Dictionary 2016 |
| <ol style="list-style-type: none"> <li>1. The capacity to <b>recover quickly</b> from difficulties; toughness</li> <li>2. The ability of a substance or object to <b>spring back into shape</b>; elasticity</li> </ol>   | Oxford Dictionaries 2015       |

## Australia

|  |  |
|--|--|
| A measure of <b>how quickly a system recovers</b> from failures.   | EMA 1998   |
| The amount of <b>change</b> a system can undergo without changing state.   | COAG 2007  |
| The ability of a social or ecological system to <b>absorb</b> disturbances while retaining the same basic infrastructure and ways of functioning, the capacity for <b>self organisation</b> and the capacity to <b>adapt</b> to stress and change. | DCC 2009   |
| The capacity to <b>prevent/mitigate, prepare</b> for, <b>respond</b> to and <b>recover</b> from the impacts of disasters.  | COAG 2009; QRA 2011:7                                      |
| The capability to <b>prevent/mitigate, prepare</b> for, <b>respond</b> to and <b>recover</b> from the impacts of disasters.  | COAG 2014  |
| [pseudo-definition]<br>The capacity to <b>prepare</b> for, <b>withstand</b> , <b>respond</b> to and <b>recover</b> from disasters  | QRA 2011: footer throughout                                |
| [pseudo-definition]<br>capacity to <b>withstand</b> and <b>recover</b> from emergencies and disasters  | COAG 2011; QRA 2011:10; State of Queensland 2011; AGD 2013 |
| [resilience characteristics] <ul style="list-style-type: none"> <li>• functioning well while under stress</li> <li>• successful <b>adaptation</b></li> </ul>   | COAG 2011  |

|  |                               |
|--|-------------------------------|
| <ul style="list-style-type: none"> <li>• self-reliance</li> <li>• social capacity</li> </ul>   |                               |
| The ability of the Queensland Government, local governments, communities, businesses and individuals to <b>prepare</b> for, <b>respond to, and manage</b> potential hazards and disasters, thereby minimising impacts and <b>rapidly recovering</b> to emerge <b>stronger and better able to cope</b> with future disaster events. | Queensland Government 2014a   |
| The ability to <b>adapt</b> to changing conditions and <b>prepare</b> for, <b>withstand</b> , and <b>rapidly recover</b> from disruption.  | Queensland Government 2014b   |
| The ability of communities to <b>continue to function</b> when exposed to hazards and to <b>adapt</b> to changes rather than returning to the original pre-disaster state.   | Productivity Commission 2014  |
| Resilient: (1) <b>Springing back; rebounding</b> . (2) <b>returning to the original form or position</b> after being bent, compressed, or stretched. (3) <b>readily recovering</b> , as from sickness, depression, or the like; buoyancy; cheerfulness.*   | The Macquarie Dictionary 1987 |

\* 'Resilience' is defined in similar terms as 'resilient power' or 'resilient action'.

### The Netherlands\*

|  |                              |
|--|------------------------------|
| The <b>speed of recovery</b> from an unsatisfactory condition†   | de Bruijn 2004a              |
| The <b>ease with which a system recovers</b> from floods‡  | de Bruijn 2004b              |
| The capacity of a dynamic system to <b>absorb</b> shocks while <b>maintaining its structure and functioning</b> (which is different from the capacity of a system to return to a certain steady equilibrium state following a disturbance). This definition focuses on 'persistence, <b>adaptivity</b> , variability, and unpredictability' and is 'measured by the magnitude of disturbance that can be <b>absorbed</b> before the system changes its structure by changing the variables and processes that control behaviour' | van Slobbe et al. 2013       |
| Striving towards an appropriate balance between <b>protection</b> , <b>prevention and preparedness</b> , both now and into the future  | Zevenbergen et al. 2013      |
| The ability of a system, community or society exposed to hazards to <b>resist</b> , <b>absorb</b> , <b>accommodate to</b> and <b>recover</b> from the effects of a hazard in a <b>timely and efficient</b> manner, including through the preservation and <b>restoration</b> of its essential basic structures and functions.§   | Weieriks and Vlaanderen 2015 |

\* Government documents from the Netherlands used in this study did not define resilience

† This definition derives from ASCE and UNESCO 1998. The author is currently a senior researcher at Deltares, specialising in flood risk management and resilience

‡ distinguished from resistance: 'the ability of such a system to prevent floods'

§ UNISDR 2009 definition. The paper identifies Weieriks as being from the Ministry of Infrastructure and the Environment (NL) and Vlaanderen as a member for Netherlands on the UN Secretary General's Advisory Board on Water and Sanitation.

### China

|                        |  |
|------------------------|--|
| No definition located. |  |
|------------------------|--|



## Deciphering resilience definitions

### Anticipate

There is some debate about the role of anticipation in achieving SES resilience. Some equate it to an attempt to achieve certainty in inherently unpredictable, complex systems (Handmer and Dovers 1996, Walker and Salt 2006, Gunderson 2010). Nevertheless it has strong ties to disaster resilience. It is a pre-requisite of disaster preparedness and risk reduction, and can motivate planned adaptation (IPCC 2012, Reghezza-Zitt et al. 2012, Matyas and Pelling 2015, UNISDR 2015a).

Anticipation includes a wide range of measures such as gathering hazard and vulnerability information and assessing it. On a shorter timescale, it also covers flood warnings. Anticipation is particularly relevant to contemporary disaster management due to projected climate change and uncertain future risks. This is well-reflected in this study's source documents, and anticipatory activities are perhaps more consistently linked to resilience than any other category of measures. It is therefore surprising that only three resilience definitions include 'anticipate'.

Anticipation usually involves evaluation (balancing options against each other and predicting their effects, costs and benefits). The dominance of technical experts in flood study and assessment processes and the use of decision-making tools such as benefit-cost analysis may create a bias towards technical resistance-style solutions (Molle et al. 2009, Wenger 2015a).

### Mitigate, prevent

This covers a wide range of measures, including resistance, avoidance (through land use planning), construction standards, drainage, ecosystem-based measures, retrofitting and relocation.

### Prepare

Preparedness measures acknowledge residual risk and cover risk awareness and contingency planning. These activities contribute to coping capacity during a disaster. Preparedness is occasionally used to encompass mitigation, i.e., a community that has invested in 'flood resilient' evacuation routes may consider itself to be better prepared.

### Cope

Coping is short-term adaptation that enables survival and continued, if impaired, functioning during and following an event. Ability to cope is dependent on capacities (and vulnerabilities) already in place prior to the event. A paradox exists whereby 'disaster' implies inability to cope. Ability to cope thus implies 'no disaster'. The emphasis is therefore on increasing the coping range (Yohe and Tol 2002, IPCC 2012). In SES resilience theory, this relates to the size of the basin of attraction (Walker et al. 2004, Liao, 2012).

Increasing the ability to cope requires system adjustments to ensure the *stability* of the human element of a system (and of components on which humans depend), thus representing a departure from ecological resilience as described by Holling (1973).

### Absorb and accommodate

These terms have a similar short-term timeframe as 'cope' but are more passive. They suggest innate structural and spatial qualities (e.g., through amphibious building standards or landscape features). In the case of flood hazards, they aptly describe ecosystem approaches which soak up, retard or store water (e.g., wetland protection, vegetation for water infiltration, unconstrained floodplains). Accommodate may also relate to social values and imply tolerance and preparedness to a degree of flooding or disruption.

### **Ability, capability and capacity**

'Ability', 'capability' and 'capacity', are sometimes used interchangeably. In the emergency sector, the USA and the UK favour the use of 'capability' (DHS 2010, Cabinet Office 2013). Australian definitions tend to distinguish 'capability' (e.g., technology, management systems and skills) from 'capacity' (e.g., staff and volunteer numbers, amount of resources, redundancy, substitutability, and mobility):

capability refers to the emergency management system's technical and other abilities to deliver a service. Capacity refers to the extent to which the system is able to sustain application of this capability for long periods or across multiple locations.

(State of Victoria 2012:32)

The USA and the UK only define the term capability:

A demonstrable ability to respond to and recover from a particular threat or hazard  
(Cabinet Office 2013:6)

to accomplish a mission, function or objective  
(DHS 2010:9)

When not used in a technical context, capacity may be applied to built form, for example, 'capacity to withstand' but it is also suggestive of social enabling and capacity building, a key element of resilience and its twin concept 'shared responsibility'. This aims for individuals and local communities to develop their own capacities for coping with disaster.

### **Withstand, resist, protect**

These terms are most strongly associated with resistance strategies and generally apply to the built form, including structural protection to prevent exposure (e.g., flood barriers) or the ability of buildings or structures to survive exposure up to a specified magnitude (e.g., water or wind velocity, flammability, earthquake shock). Thus they could apply to either 'exposure prevention' or 'accommodate: built environment' strategies.

### **Respond**

Response refers to emergency capacity and capability during an event. As such, it is also related to 'cope', 'absorb and accommodate' and 'withstand and resist'. However these are properties that need to be developed prior to an event taking place.

### **Maintain essential structures and functions**

[or preserve; retain]. This is a dominant concept in SES resilience theory and relates to system change (Walker *et al.* 2004). Applied to disaster management, the phrase sometimes refers to functional continuity during a disaster (which is akin to the ability to 'resist', 'absorb' or 'accommodate'). Other definitions refer to the degree of system change following a disaster. These often display a definitional tension between adaptability /change and the need to stay the same. This suggests desire for 'change at the margins' (Handmer and Dovers 1996) without significant transformation of existing power structures and feedbacks.

### **Adapt, learn, change, reorganise**

These terms are widely used in resilience definitions, but the degree of change is often to be tempered by a parallel requirement to maintain the existing system and functions. This implies incremental change that reinforces the status quo.

## Transformation

Transformation involves change to feedbacks, functions and structures, that is, lowering the resilience of an undesirable resilience régime and moving to a more desirable one. It is therefore in opposition to a resilient status quo.

Transformation is rarely used in resilience disaster definitions, an exception being the International Panel on Climate Change (IPCC 2014). The IPCC definition requires systems to remain essentially the same while maintaining the 'capacity' for transformation. This ambiguous definition implies that while transformation should be possible, it should not actually take place.

## Rapid recovery

This is a key element of engineering resilience. However, many have observed a tension between rapid recovery and improved recovery, which generally requires more time and money (e.g., Wright 2000, Kates *et al.* 2006). One solution is to plan for windows of opportunity so that administrative arrangements, resourcing and approvals are already in place.

## Resistance language in text

As well as appearing in definitions, resistance wording was sometimes used in text, particularly in Australia and the USA. References that connected the words 'withstand', 'resist', or 'protect' to resilience in text included for Australia: (COAG 2009, Australian Government 2010, COAG 2011, QRA 2011, AGD 2012*a*, AGD 2012*b*, QRA 2012, State of Victoria 2012, COAG 2012, AGD 2013, DAE 2013, Queensland Government 2014*a*, State of Victoria 2015); and for the USA: (ASCE 2009, IPET 2009, NRC 2012*b*, ASCE 2013, CNY 2013, HSRTF 2013).

## Discussion on the use of resilience definitions

Dictionary definitions from English language speaking countries reveal a strong influence of engineering-inspired interpretations of resilience. This means that public understanding about resilience will be coloured by engineering interpretations. Academic interpretations of disaster resilience tend to derive more from ecological systems research (which disputes the ideal of a stable state). The lack of systems-inspired dictionary definitions of resilience has implications not only for the public understanding of disaster resilience but also the application and communication of resilience by bureaucrats, politicians and policymakers in the emergency management sector.

There is a notable lack of consistency of definitions between and within documents, especially in the USA and Australia. Documents were found to contain up to three definitions with slightly different wording. The lack of consistency between resilience definitions is a well-discussed theme in disaster resilience studies, although most studies focus on theoretical rather than operational definitions.

## *Global*

Global definitions exhibit a division, whereby sources with an emergency management outlook generally include 'resistance' terms but climate change adaptation related sources do not. This division is less clear in other case studies.

The UNISDR is highly influential in setting the disaster resilience agenda globally and some organisations use the UNISDR definitions in preference to local ones. Examples include a paper written by government officials from the Netherlands (Weieriks and Vlaanderen 2015), an early USA report (SDR 2005), and the Deloitte Australian Business Roundtable for Disaster Resilience (DAE 2013, DAE 2014). DAE's stated focus (p.5) is on the pre-disaster 'resist' component of the UNISDR (2009) definition. DAE supports resistant measures, such as dams, levees and building standards. It

also supports non-structural options including information, incentives and methodologies to support decision-making; land use planning; and preparedness.

### *USA*

In the USA, resistance terms appear in almost every definition, and where this is not the case, resistance language is often used when describing resilience in the text (e.g. CNY 2013, pages 7, 39; see also global UNISDR 2015a S.17). Executive orders and presidential policy directives often reflect the prevent/mitigate-prepare-respond-recover (PPRR) framework in resilience definitions, with ‘anticipation’ sometimes added and mitigate/prevent becoming adapt.

### *UK*

Of the UK definitions, most incorporate resistance terminology.

### *China and The Netherlands*

These are both countries where ‘resilience’ is not a local word and understanding has to be gained from elsewhere. No disaster resilience definitions were provided by Chinese sources and few resilience definitions appear documents from the Netherlands. Some definitions derive from overseas sources (the UNISDR and USA). An early Netherlands definition focuses on the engineering ideal of rapid recovery, which is interesting as overall recovery did not rate as highly as most other categories in the Netherlands study results. Sources with the rapid recovery definition were concerned with modifying the existing flood defence system to enable minimal damage and rapid recovery in the event of failure. One definition draws upon systems theory.

### *Australia*

Australian disaster resilience definitions demonstrate a close relationship with the prevent-prepare-respond-recover (PPRR) framework, which encompasses resistance measures. Resistance terminology is common in pseudo-definitions.

Australian policy documents frequently choose not to define resilience, even when it is a central concept (DOTARS 2004, COAG 2011, State of Queensland 2011, State of Victoria 2012, AGD 2013). The primary definition for some sources, including legal agreements, is based on the PPRR framework (COAG 2009, QRA 2011, COAG 2014). An alternative de facto definition appears in the text of many documents relating to the National Strategy for Disaster Resilience: “capacity to withstand and recover from emergencies and disasters” (COAG 2011, QRA 2011, State of Queensland 2011, AGD 2013). While technically using the COAG 2009 definition, the Queensland Reconstruction Authority (QRA 2011) prominently displays the words “The capacity to prepare for, withstand, respond to and recover from disasters” on title pages and in the footer of every double page. This suggests that while wishing to use a national definition, the QRA did not entirely agree with it. It therefore created its own de facto resilience definition by amending the de facto COAG 2011 definition (which it also cites).

While it may be a coincidence, similarity was noted between the Queensland (Queensland Government 2014b) and USA (White House 2013b) definitions, between the UK Pitt review definition (Pitt 2008:240) and Australia’s COAG 2011 pseudo-definition.

# Case study narratives of disaster resilience interpretations in China, Netherlands, USA, Australia and international organisations

## China

References to disaster resilience in China are rare in both government and academic flood literature. Given the word's Latin origin it is unlikely to hold the same political resonance and power in Chinese as it does in English<sup>1</sup>.

There is little consistency among Chinese academics about the interpretation of resilience in the context of Chinese flood policy. Gao et al. (2014) equate resilience to resistance strategies, such as sea walls and the financial capacity to build them. Structural measures also feature strongly in a discussion of resilience in Shanghai (Lu and Lewis 2015). Others link resilience to European 'room for the river' style approaches and 'soft' management measures (Cheng 2006, Huang et al. 2013, Jiang et al. 2013). This interpretation has been influenced by China's catastrophic 1998 floods in which key dykes failed. Post-disaster policies reveal a paradigm shift towards 'harmonious coexistence of man and nature' (Ma et al. 2010) which has resulted in a move away from structural control, towards damage reduction and flood management (Cheng 2006, Ma et al. 2010). This approach favours measures such as resettlement out of high risk areas, improved warning systems and evacuation. By contrast, Xiao et al. (2014), take a broad, societal view of resilience, examining how factors such as population growth, agricultural capacity, climate variation and culture affect the availability of adaptive options, with unresolved drivers gradually restricting options (and resilience) over time.

The word 'resilience' is not used in English translations of Chinese flood or climate policy documents, nor related research institution reports (Zhang and Wen 2001, CCICED 2004, P.R.C. 2007, P.R.C. 2012, P.R.C. 2015). However, China participates in international resilience initiatives including the UNISDR's 'Making Cities Resilient Campaign' (UNISDR 2012, CAS 2014, Smith 2014). As part of this involvement, Chengdu pursued resilient development following the 2008 Wenchuan earthquake and is currently a role model for UNISDR's resilient cities campaign (CMPG 2012, UNISDR 2015b). Interestingly, the municipality's submission never uses the word 'resilience'. Prominent among Chengdu's strategies have been the rapid rebuild and reinforcement of roughly 635,000 buildings and associated infrastructure; financial subsidies; disaster forecasting, risk assessment and early warning; awareness raising; and response capability improvements. Primary responsibilities have been devolved to the local level and to residents. In terms of prevention, hazard areas have been designated, 4,000 households were relocated and infrastructure such as dykes and reservoirs have been built and reinforced. While physical reconstruction was rapid, some suggest it may not lead to long term resilience, and issues of rebuild quality and insufficient investment in rebuilding economies and communities have been raised (Olshansky 2013, Smith 2014). Nevertheless, Chinese interpretations of resilience incorporate the quality of 'rebound', shared information and shared responsibility.

---

<sup>1</sup> Interestingly however, there is a Chinese story very similar to Aesop's 'Oak and Reed' tale in the *Tao de Ching* (chapter 76), including the words: "The gentle and yielding is the disciple of life.....A tree that is unbending is easily broken." (Lao Tsu, translated by Feng and English, 1973). In Taoism, water is Yin, the yielding female principle and it is viewed as being more powerful than Yang, the male principle; gender and flood control could form its own interesting study. The similarity of the Chinese and European tales (and their durability) suggests they have universal appeal and could be a culturally relevant way of equating the word 'resilience' with 'living with floods' or flood accommodation and distancing it from resistance options in the non-academic domain.

## The Netherlands

Dutch interpretations of disaster resilience are not static and mirror contemporary flood management policy. While initially, both academics and (the few) government documents that used the term 'resilience' associated it almost exclusively with novel 'room for the river' strategies, the range of measures currently linked with resilience now encompasses traditional structural measures as well.

Traditional dyke strengthening was able to cope with small floods. However, a series of near-miss flood events in the 1990s revealed this to be inadequate for large-scale disasters and future climate scenarios. In the early 2000s, resilience was used by Dutch academics to describe innovative methods of providing more room for rivers through relocation of dykes inland, the development of new floodways ('green rivers') and better structuring (compartmentalising) of existing polders. Instead of preventing floods, these measures aim to reduce flood peaks and enable gradual flooding of least valuable areas first. They also require significant transformation in terms of spatial planning, flood-compatible land use and buildings. This view of resilience, which sits within the pre-existing structural landscape of Dutch flood management, distinguishes 'resistance' strategies, such as dyke strengthening from 'resilience' strategies that aim to increase flexibility and buffers into the system (Vis et al. 2003, de Bruijn 2004b, Klijn et al. 2004, Smits et al. 2006, Wolsink 2006).

These early conceptions about resilience have since been reassessed by some of these same academics who now prefer the term 'robustness'. Robustness incorporates both resistance and the degree to which the hazard, once it overcomes the resistance threshold, can be made gradual through improved system design (Mens et al. 2011, Mens et al. 2015). Others in the academic community (e.g., van Slobbe et al. 2013, Engel et al. 2014) continue to view 'hard engineering' as an impediment to achieving resilience. Engel et al., for example, criticise new embankments built along the River Maas, concluding:

"our findings suggest that these changes could transform two self sufficient, responsible and resilient communities into two dependent, less prepared and therefore more vulnerable communities"  
(Engel et al. 2014:880)

The term 'resilience' has taken time to enter into (English translations of) Dutch government policies, and is absent from many key documents, including flood terminology documents; the influential Deltacommissie report; national spatial planning policy; water development plans; and many room for the river program documents (Dutch Government 2006, Deltacommissie 2008, Dutch Government 2008, Dutch Government 2011, Dutch Government 2015).

Despite its absence from these documents, it is clear that the Dutch government associates room for the river flood policies with resilience, including initiatives to set back dykes and broaden the river at Nijmegen (Dutch Government 2012, Nijssen 2012), and the current National Water Plan which describes climate change policies that increase space for rivers as 'resilience' (Dutch Government 2009). Resilience is strongly linked to spatial planning by both Dutch theoreticians and government agencies (e.g. NEAA 2009, Dutch Government 2014, Weieriks and Vlaanderen 2015).

While policy documents do not offer a definition of 'resilience', work published by government officials suggests that the 2009 UNISDR definition has been adopted (Weieriks and Vlaanderen 2015). This definition incorporates the word 'resist', under which structural mitigation such as dykes fit. This may explain the more recent association of dyke strengthening with resilience, for example, in Delta Programme documents.

The current Delta Programme emerged from the Deltacommissie's report (2008) and is described as a resilience strategy (Dutch Government 2013, Zevenbergen et al. 2013), although annual Delta Programme documents offer little identification of the overall program with the term 'resilience' until 2014 (Dutch Government 2014). The Delta Programme is broad and covers *resistance* measures, such as further reinforcement of dykes in heavily populated areas, as well as room for the river style measures and preparedness in more rural areas. The correlation of resilience with resistance also appears in other recent government documents. For example, a report prepared by PBL Netherlands Environmental Assessment Agency associates resilience with 'unbreachable dykes', designed not to fail if overtopped and deems flood-resilient construction unnecessary in such areas:

“the consequences of flooding are always less damaging when areas are protected by unbreachable dykes” (NEAA 2011:10).

However, unbreachable dykes can only provide protection only up to a limited height and could be viewed as an unrealistic long term goal by some, depending on the timeframe considered by policymakers (Rahmstorf 2010).

Measures associated with 'disaster resilience' in the Netherlands have thus evolved to reflect national policy. While initially relating almost exclusively to new 'living with floods' strategies, most recent Dutch policy documents also incorporate resistance measures.

## USA

The USA has an all-encompassing view of disaster resilience, and it is linked to anticipatory measures, development controls, construction standards, ecosystem-based measures, preparedness, institutional reform, response capacity and rapid recovery. Resilience is almost universally associated with climate change adaptation, and some sources also describe climate change mitigation as a resilience measure to avoid future flooding.

Intriguingly, few references associate exposure reduction structures, such as levees, with resilience. This is likely to be due to recent major flood disasters characterised by failure of structural protection, such as the 1993 mid-west flood and 2005 flooding in New Orleans (Changnon 2000, Burby 2006, IPET 2009, NCLS 2009). Even where such measures are included in the suite of resilience measures, there is recognition that this type of measure can reduce risk awareness and increase flood consequences (NRC 2012*b*, FEMA 2015*d*). Reports into infrastructure and dam and levee safety equate resilience not with the structures themselves, but rather, with their redesign, improved management, maintenance, operation, legal enforcement, risk communication and similar measures (ASCE 2009, NRC 2012*a*, ASCE 2013). Similarly, a review into the 2005 New Orleans flooding attributed poor resilience to economic decisions, poor flood wall design and the lack of integration of flood defence systems and components (IPET 2009). Current New Orleans flood management strategies incorporate levees and flood walls, but such measures are described as 'protection' and are distinguished from 'resilience' measures, which are described in terms of enhancing ecosystem buffers, improved construction standards and buyouts (CPRA 2012).

While most USA documents examined do not link resilience to structural protection, a resilience plan prepared by the City of New York in the wake of Hurricane Sandy in 2012 is a notable exception (CNY 2013). Adamant that retreat from the coastline is not an option, the plan projects that climate change will extend the current 100-year floodplain from 11% of the city's area to 24% by 2050. The city has encouraged new waterfront investment and anticipates that the majority of population growth will occur in areas most at risk. In this context, the plan equates structural protection (to the

1 in 100 AEP level) to resilience. The plan does not project sea level rises beyond 2050, nor consider the adequacy of current development growth and structural protection strategies beyond this date.

Published just two months after New York's resilience plan, a report by the Hurricane Sandy Rebuilding Task Force references flood walls only to say they breached during the disaster. However, it strongly promotes ecosystem based approaches and investing in improved rebuild standards (HSRTF 2013). Taskforce findings have been influential in guiding federal climate and flood policy (White House 2013c, FEMA 2015c). While recognition of structural measures continues, the emphasis of federal flood risk policy is on a higher standard of risk avoidance and use of ecosystems-based approaches (FEMA 2015c, FEMA 2015d).

Resilience in the USA is also strongly associated with preparedness. This includes public awareness of risks, preparing disaster plans, continuity of critical infrastructure and services and institutional reform to improve mitigation incentives and program delivery. Preparedness activities aim to reduce damages through better planning, management and behaviour change. However, Richards (2010) notes that 'all plans work before the disaster' and preparedness activities may provide a false sense of security. The 2005 New Orleans disaster occurred shortly after the city had successfully completed a disaster planning exercise on 'Hurricane Pam', a theoretical storm more severe than Hurricane Katrina (Richards 2010). More concerning is the observation that by improving *perceptions* of safety, through well-intentioned emergency planning or levee building, governments also satisfy political objectives of maintaining land values and economic development in hazardous areas (Burby 2006, Richards 2010).

Shared responsibility and the need for partnerships are highlighted in some sources. This is particularly pertinent because, as a federation, the US Federal Government has limited power over some issues that are seen as key to improving resilience, such as land use planning, construction standards and their enforcement. Institutional incentives, including conditional federal funding, are recommended (NRC 2012b) and adopted (Wright 2000, White House 2015) to help achieve these results. As many critical infrastructure assets are in the private domain, public-private partnerships are viewed as a priority to ensure business continuity in the event of disaster.

## Australia

In Australia, the concept of disaster resilience was first used extensively in an influential report to government on disaster mitigation first written in 2002 (DOTARS 2004). The report's interpretation of resilience remains current, and includes a risk management approach based on hazard information and risk assessment; the concept of local communities sharing responsibility for risk management; preparedness; capacity building; and the continuity of critical infrastructure and services. Critically, the focus is on disaster mitigation, an emphasis that continues in more recent documents.

Through the National Strategy for Disaster Resilience (COAG 2011), resilience is now central to Australian disaster management, and is the basis of competitive grants programs and state government policies. The strategy is broad and offers no disaster-specific measures (such as fuel reduction or efficient drainage). Instead it stresses the importance of preparedness and capacity building. For the physical environment, the strategy advises land use planning, construction standards and broaches the inadvisability of rebuilding in hazardous areas following an event.

Improved development planning is a common theme in Australian resilience documents. However, competing development needs often result in limited development control of floodplains (Wenger 2013; 2015b). Theoretically, accurate understanding of risks leads to improved decision making and



to this end, Australia's National Partnership Agreement on Natural Disaster Resilience has had a strong focus on generating hazard information. However, understanding of risks is no guarantee of good planning outcomes. In an example from Queensland, a 970-dwelling development was approved in an area so risky that approval conditions required an evacuation helipad, lifeboats and three days' food supply (Productivity Commission 2014). While local governments are primarily responsible for land use planning and risk management (AGD 2012a), development legislation is a state government responsibility. Approval in this case was attributed to lack of immunity from legal challenges, suggesting that state institutional arrangements do not always support development control rhetoric; 'shared responsibility' devolves and absolves higher levels of government.

Australian documents suggest a stronger linkage of resilience with structural mitigation than other countries. Moreover, some of that association is obscured under the general term 'mitigation'. For example, the Queensland's Resilience Strategy (Queensland Government 2014a) links resilience with the implementation of specified programs. Some include preparedness but others are exclusively structural in focus (e.g., levee building and raised roads with flood resistant surfaces), with measures such as house raising and property buyback ineligible (Queensland Government 2013, Queensland Government 2015). Similarly, Victoria's disaster management policies refer to mitigation (State of Victoria 2012, State of Victoria 2015) and its resilience programs offer evidence of support for both structural and preparedness measures. However, there is no evidence of state-supported house raising or relocation activities (State of Victoria 2014a, State of Victoria 2014c). In part, this can be attributed to perceptions about private benefits (BTRE 2002).

Perhaps least linked with resilience are the ecosystem based measures. Where this is covered, it sometimes seemed tokenistic. Measures such as wetland protection may only merit one line in a table (Productivity Commission 2014, Volume 2, p.374) while whole sections or chapters are devoted to measures such as betterment and levees. However, the retention of existing floodplain functions, such as flood conveyance and storage are supported in floodplain management and development planning documents (QRA 2012, AGD 2013, State of Victoria 2014b, Queensland Government 2014c).

The importance of improved rebuild following disasters is linked to resilience in key sources but many highlight that achieving this objective is impeded by ineffective administrative arrangements (DOTARS 2004, QRA 2011, Productivity Commission 2014). A similar situation occurred in the USA when it first implemented improved rebuild policies, which led to improved administrative and budgetary support (Wright 2000, pages 69, 78). Following consecutive floods in Queensland, political pressure has increased and reforms to disaster financing are currently under discussion (Productivity Commission 2014).

### **International organisations**

Resilience is a primary objective in international organisations, crossing the policy spheres of climate adaptation, sustainability, economic development and disaster risk reduction. The Hyogo Framework for Action (HFA) has been especially influential in defining and promoting disaster resilience internationally.

The HFA has recently been replaced by the Sendai Framework (SF). The SF reduces the prominence of the term resilience and 'disaster risk reduction' takes centre stage instead. In some parts of the document, preventing and reducing disaster risk are said to strengthen resilience (e.g., paragraphs 5, 17 and priority 3); in others, reducing disaster risk and building resilience appear more weakly linked (e.g., priorities 1, 2 and 4).

Global case study documents tend to exhibit a high level of support for a wide range of measures. Guided by the HFA, documents strongly associate resilience with all measures believed to contribute to disaster risk reduction, including improved development and construction controls, resistance measures, ecosystem based measures, disaster warnings and preparedness. Sources also recognise that many developing countries have low response capacity, and this is incorporated. The global case study thus reflects the need to be inclusive on the international stage to accommodate the varying needs and approaches of all countries.

Addressing underlying social vulnerabilities to disasters is a dominant theme of international documents. International resilience documents explore this in great detail and argue that addressing it is fundamental to achieving societal resilience to disasters, climate threats and other stressors (e.g. Jha et al. 2012, UNISDR 2015c). This is the most significant difference in emphasis compared with the other case studies examined, and is consistent with the aim to address underlying vulnerabilities as part of the international development agenda.

Of the other case studies, the USA is most closely reflects the awareness of social vulnerability in global case study, perhaps due to evidence that the socially disadvantaged were disproportionately affected by Hurricane Katrina floods (Kates et al. 2006, Tierney 2006). Sources from the Netherlands rarely cover disadvantaged groups. Those that do either discuss it in the context of overseas policy (Weieriks and Vlaanderen 2015) or deny that inequity (based on access to information, resources and health) is an issue in the Netherlands (de Bruijn 2004b). However, (Wolsink 2006) makes it clear that there are power inequities in the Dutch development system. Addressing underlying social issues is also muted in Australian sources. The 2012 Queensland Floods Commission of Inquiry revealed that planning controls for affordable housing were weaker and that vulnerable people (such as those in aged care) were housed in risky areas (QFCI 2012, Wenger 2013). However, resilience strategies that address underlying vulnerability tend to promote targeted information dissemination and do not display an understanding of these deeper, systemic issues. This is also reflected in Australian vulnerability assessments which are more likely to be mentioned in the context of infrastructure than social groups. To some extent underlying social disadvantage is an intractable problem, dictated by right wing – left wing politics. It is easily promoted on the international stage but may be harder to implement nationally.

## **‘Oak and Reed’ tales**

### **Aesop’s fables**

Aesop was an ancient Greek storyteller. He may be no more than a story himself as no conclusive evidence has been found that he lived. The earliest versions of Aesop's Fables are found in the 8<sup>th</sup> Century BCE by the Greek poet Hesiod. They have been retold continuously by many authors ever since (see chronology of fables in Gibbs 2002).

According to Gibbs (2002), the tales were originally performed. When later they were written, authors offered varying interpretations of the tales’ morals and meanings. Most fables had a didactic purpose and were used by orators and philosophers. Others were intended to entertain and posed riddles or were comic. In this style of fable, final phrase was like the punchline of a joke. It is only in recent times that the fables have been viewed as children’s tales.

The tales commonly include a promythium (‘pro-mythos’ = before story), which is the moral of the story, and an epimythium (‘epi-mythos’ = after story) to make sure the point of the story is absolutely clear. The epimythium draws an explicit link between the fable and the real world so people can apply the story to their own lives. There may also be an endomythium (embedded within the story itself).

Transformative adaptation often entails a change in underlying values. This tale’s survival across time and space suggests its potential to be used as a narrative for cognitive change, something Boulton (2016) argues is needed to address some of the big issues currently facing humanity.

### **A selection of ‘Oak and Reed’ tales across time and between cultures**

Note that in some versions, the story is called ‘The Olive and the Reed’.

#### **Aesop’s fable as retold by Aphthonius (4th century CE)**

##### **The Oak Tree and the Reed**

*A story about a reed and an oak, urging us not to rely on strength.*

A reed got into an argument with an oak tree. The oak tree marvelled at her own strength, boasting that she could stand her own in a battle against the winds. Meanwhile, she condemned the reed for being weak, since he was naturally inclined to yield to every breeze. The oak tree was torn up by the roots and toppled over, while the reed was left bent but unharmed.

*Those who adapt to the times emerge unscathed.*

(translation: Gibbs 2002)

This version is interesting for a number of reasons. It shows that strength is accompanied by pride. This seems to be an echo of modern day hubris in the face of climate change. The epimythium is also very modern and could easily be referring to the ability to adapt to climate change.

## La Fontaine's (1668) retelling of Aesop's fable

### Le Chêne et le Roseau

Le chêne un jour dit au roseau:  
Vous avez bien sujet d'accuser la nature.  
Un roitelet pour vous est un pesant fardeau,  
Le moindre vent qui d'aventure  
Fait rider la face de l'eau  
Vous oblige à baisser la tête.  
Cependant que mon front, au Caucase pareil,  
Non content d'arrêter les rayons du soleil,  
Brave l'effort de la tempête.  
Tout vous est aquilon, tout me semble zéphyr  
Encor si vous naissiez à l'abris du feuillage  
Dont je couvre le voisinage,  
Vous n'auriez pas tant à souffrir:  
Je vous défendrais de l'orage;  
Mais vous naissez le plus souvent  
Sur les humides bords des royaumes du vent.

La nature envers vous me semble bien injuste  
Votre compassion, lui répondit l'arbuste,  
Part d'un bon naturel; mais quittez ce souci:  
Les vents me soint moins qu'à vous redoutables;  
Je plie, et ne romps pas. Vous avez jusqu'ici  
Contre leurs coups épouvantables  
Résiste sans courber le dos,  
Mais attendons la fin. Comme il disait ces mots,  
Du bout de l'horizon accourt avec furie  
Le plus terrible des enfants  
Que le nord eut portés jusque-là dans ses flancs.  
L'arbre tient bon, le Roseau plie,  
Le vent redouble ses efforts,  
Et fait si bien qu'il déracine  
Celui de qui la tête au ciel était voisine  
Et dont les pieds touchaient à l'empire des morts.

(La Fontaine 1880)

### The Oak and the Reed

The oak said one day to the reed:  
You have good grounds to complain against nature.  
To you, a goldcrest [tiny bird] is a heavy burden,  
The slightest breeze that arises  
That ripples the water's surface  
Causes you to bow your head.  
However my great crown, as mighty as the Caucasus  
Not only blocks the rays of the sun,  
But resists the tempest's labours.  
For you, life is like a north wind; for me, a zephyr  
Even so, were you to grow under my leaves  
With which I shelter my neighbours,  
You would not have to suffer so much:  
I could protect you from storms;  
But you most often grow  
On damp banks in the realm of wind.

To me, nature seems terribly unfair to you,  
Replied the reed: your kindness  
Is a noble gift; but do not be concerned:  
Wind is less formidable to me than it is to you;  
I bend and do not break. Until now  
Against the most horrific gusts  
You have resisted without bending your back,  
But let's wait and see how things end.  
As the reed said these words,  
From the edge of the horizon raced with fury  
The most dreadful progeny  
The north had yet produced.  
The tree held itself straight, the reed bent,  
The wind redoubled its efforts,  
And worked so hard that it uprooted  
Him, whose head had reached the heavens,  
And whose feet now touched the kingdom of death.

(translation: Wenger)

Jean de La Fontaine's 'Fables' were originally published in 1668. This version is interesting because it includes the idea of *protection* by the oak (in a condescending tone). Levees and flood mitigation dams are commonly described as structures that 'protect' and 'defend'. The reed shows its perversity by exposing itself to the elements and refusing protection.

**Aesop's fable, as retold by Steinhöwel (in French) and translated into English by William Caxton (1484)**

The XX fable maketh mencion of the tree and of the reed  
None ought to be proud ageynst his lord  
But oughte to humble hym self toward hym  
As this fable reherceth to vs of a grete tre  
whiche wold neuer bowe hym for none wynd  
And a reed whiche was at his foote bowed hym self as moche as the wynd wold  
And the tree sayd to hym  
why dost thou not abyde styll as I doo  
And the reed ansuerd  
I haue not the myght whiche thou hast  
And the tree sayd to the reed proudly  
Than haue I more strengthe  
than thou  
And anone after came a grete wynde  
whiche threwe doune to the ground the sayd grete tree  
and the reed abode in his owne beyng  
For the proud shall be allwey humbled  
And the meke and humble shalle be enhaunced  
For the roote of alle virtue is obedyence and humylyte

(Lenaghan 1967)

This was the first version printed in English. It shows the varied moral interpretations that can be made. Here it is the individual who needs to yield to feudal lords to survive. According to Gibbs (2002), Caxton's book of Aesop's fables became the basis of many English proverbs.

**Tao de Ching, Chapter 76, by Lao Tsu 6th Century BCE**

A man is born gentle and weak.  
At his death he is hard and stiff.  
Green plants are tender and filled with sap.  
At their death they are withered and dry.

Therefore the stiff and unbending is the disciple of death.  
The gentle and yielding is the disciple of life.

Thus an army without flexibility never wins a battle.  
A tree that is unbending is easily broken.

The hard and strong will fall.  
The soft and weak will overcome.

(translation: Feng and English 1973)

This fragment of ancient Chinese wisdom has remarkably similar imagery and lessons to the 'Oak and Reed' tale. In Taoism, water is Yin, the yielding female principle and it is viewed as being more

powerful than Yang, the male principle. This verse demonstrates that the tale is transferrable across cultures. It could be used as a way of equating 'resilience' with 'living with floods' or flood accommodation.

## LITERATURE CITED

- Adger, W. N., N. W. Arnella, and E. L. Tompkins. 2005. Successful adaptation to climate change across scales, *Global Environmental Change*, 15(2): 77-86. doi:10.1016/j.gloenvcha.2004.12.005.
- AGD. 2012a. *Australian Emergency Management Arrangements: second edition*. Australian Government Attorney-General's Department, Canberra, Australia.
- AGD. 2012b. *National Strategy for Disaster Resilience Companion Booklet*. Commonwealth of Australia Attorney-General's Department, Canberra, Australia.
- AGD. 2013. *Managing the floodplain: a guide to best practice in flood risk management in Australia*. Australian Emergency Management Institute, Attorney General's Department, Canberra, Australia.
- ASCE. 2009. *2009 Report Card for America's Infrastructure*. American Society of Civil Engineers. [online] URL: [http://www.infrastructurereportcard.org/2009/sites/default/files/RC2009\\_full\\_report.pdf](http://www.infrastructurereportcard.org/2009/sites/default/files/RC2009_full_report.pdf) [accessed 6 October 2015].
- ASCE. 2013. *2013 Report Card for America's Infrastructure*. American Society of Civil Engineers. [online] URL: <http://www.infrastructurereportcard.org/wp-content/uploads/2013ReportCardforAmericasInfrastructure.pdf> [accessed 6 October 2015].
- Australian Government. 2010. *Critical Infrastructure Resilience Strategy*. [online] URL: <http://www.tisn.gov.au/Documents/Australian+Government+s+Critical+Infrastructure+Resilience+Strategy.pdf> [accessed 9 October 2015].
- Boulton, E. 2016. Climate change as a 'hyperobject': a critical review of Timothy Morton's reframing narrative. *Climate Change* 7:772-785. doi:10.1002/wcc.410.
- BTRE. 2002. *Benefits of Flood Mitigation in Australia*. Bureau of Transport and Regional Economics, Department of Transport and Regional Services, Canberra.
- Burby, R. J. 2006. Hurricane Katrina and the paradoxes of government disaster policy: bringing about wise governmental decisions for hazardous areas. *The annals of the American academy of political and social science* 604:171-191. doi:10.1177/0002716205284676.
- Cabinet Office. 2011. *Strategic National Framework on Community Resilience*. UK Government. [online] URL: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/60922/Strategic-National-Framework-on-Community-Resilience\\_0.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/60922/Strategic-National-Framework-on-Community-Resilience_0.pdf) [accessed 18 November 2013].
- Cabinet Office. 2013. *Lexicon of UK civil protection terminology*. UK Cabinet Office. [online] URL: <https://www.gov.uk/government/publications/emergency-responder-interopability-lexicon> [accessed 7 August 2015].
- CAS. 2014. *Disaster Risk Science Conference kicks off in China*. Institute of Remote Sensing and Digital Earth. Chinese Academy of Sciences. [online] URL: [http://english.radi.cas.cn/News/PN/201406/t20140607\\_122301.html](http://english.radi.cas.cn/News/PN/201406/t20140607_122301.html) [accessed 23 June 2015].
- CCICED. 2004. *Promoting integrated river basin management and restoring China's living rivers*. China Council on International Cooperation on Environment and Development Task Force on Integrated River Basin Management, Beijing, People's Republic of China.
- Changnon, S. A. 2000. The record 1993 Mississippi River Flood: a defining event for flood mitigation policy in the United States. Pages 288-301 in D. J. Parker, editor. *Floods*, Volume 1. Routledge. London, New York.
- Cheng, X. 2006. Recent progress in flood management in China. *Irrigation and Drainage* 55:S75-S82. doi:10.1002/ird.241.
- CMPG. 2012. *Local Government Profile: Chengdu, China*. Chengdu Municipal People's Government, UNISDR. [online]. URL: <http://www.preventionweb.net/applications/hfa/lgsat/en/image/href/506> [accessed 24 June 2015].
- CNY. 2013. *PlaNYC: a stronger, more resilient New York*. City of New York. [online]. URL: [http://s-media.nyc.gov/agencies/sirr/SIRR\\_singles\\_Lo\\_res.pdf](http://s-media.nyc.gov/agencies/sirr/SIRR_singles_Lo_res.pdf) [accessed 29 September 2015].
- CNY. 2013. *PlaNYC: a stronger, more resilient New York*. City of New York. [online] URL: [http://s-media.nyc.gov/agencies/sirr/SIRR\\_singles\\_Lo\\_res.pdf](http://s-media.nyc.gov/agencies/sirr/SIRR_singles_Lo_res.pdf) [accessed 29 September 2015].

- COAG. 2007. *National Climate Change Adaptation Framework*. Council of Australian Governments; Department of Climate Change and Energy Efficiency. [online] URL: <http://www.climatechange.gov.au/government/initiatives/national-climate-change-adaptation-framework.aspx> [accessed 5 November 2012].
- COAG. 2009. *National Partnership Agreement on Natural Disaster Resilience*. COAG Standing Council for Federal Financial Relations. [online] URL: [http://www.federalfinancialrelations.gov.au/content/npa/environment/natural\\_disaster\\_resilience/national\\_partnership.pdf](http://www.federalfinancialrelations.gov.au/content/npa/environment/natural_disaster_resilience/national_partnership.pdf) [accessed 8 November 2012].
- COAG. 2011. *National Strategy for Disaster Resilience: building our nation's resilience to disasters*. Council of Australian Governments, Canberra, Australia.
- COAG. 2012. *Roles and Responsibilities for Climate Change Adaptation in Australia*. Council of Australian Governments. [online] URL: <https://www.coag.gov.au/sites/default/files/Roles%20and%20Responsibilities%20for%20Climate%20Change%20Adaptation.pdf> [accessed 12 October 2015].
- COAG. 2014. *National Partnership Agreement on Natural Disaster Resilience: July 2013 - June 2015*. Council of Australian Governments. [online] URL: [http://www.federalfinancialrelations.gov.au/content/npa/environment/natural\\_disaster\\_resilience/national\\_partnership\\_2014-3.pdf](http://www.federalfinancialrelations.gov.au/content/npa/environment/natural_disaster_resilience/national_partnership_2014-3.pdf) [accessed 26 June 2015].
- CPRA. 2012. *Louisiana's Comprehensive Master Plan for a Sustainable Coast*. Coastal Protection and Restoration Authority of Louisiana, Baton Rouge, LA. [online] URL: [http://issuu.com/coastalmasterplan/docs/coastal\\_master\\_plan-v2?e=3722998/2447530](http://issuu.com/coastalmasterplan/docs/coastal_master_plan-v2?e=3722998/2447530) [accessed 25 September 2015].
- DAE. 2013. *Building our nation's resilience to natural disasters*. Deloitte Access Economics; Australian Business Roundtable for Disaster Resilience and Safer Communities. [online] URL: [http://www2.deloitte.com/content/dam/Deloitte/au/Documents/Services/Corporate%20Finance/Access%20Economics/Deloitte\\_Natural\\_disasters\\_June2013.pdf](http://www2.deloitte.com/content/dam/Deloitte/au/Documents/Services/Corporate%20Finance/Access%20Economics/Deloitte_Natural_disasters_June2013.pdf) [accessed 11 November 2013].
- DAE. 2014. *Building an open platform for natural disaster resilience decisions*. Deloitte Access Economics; Australian Business Roundtable for Disaster Resilience and Safer Communities. [online] URL: <http://www2.deloitte.com/content/dam/Deloitte/au/Documents/finance/deloitte-au-fas-building-open-platform-natural-disaster-16-july-2014-240914.pdf> [accessed 12 October 2015].
- DCC. 2009. *Climate Change Risks to Australia's Coast: a first pass national assessment*. Australian Government, Department of Climate Change, Canberra. [online] URL: <https://www.environment.gov.au/climate-change/adaptation/publications/climate-change-risks-australias-coasts> [accessed 14 November 2012].
- de Bruijn, K. M. 2004a. Resilience and flood risk management. *Water Policy* 6:53-66.
- de Bruijn, K. M. 2004b. Resilience indicators for flood risk management systems of lowland rivers. *International Journal of River Basin Management* 2(3):199-210. doi:10.1080/15715124.2004.9635232.
- DEFRA. 2005. *Making space for water: Taking forward a new Government strategy for flood and coastal erosion risk management in England. First Government response to the autumn 2004 Making space for water consultation exercise March 2005*. Department for Environment, Food and Rural Affairs. [online] URL: <http://archive.defra.gov.uk/environment/flooding/documents/policy/strategy/strategy-response1.pdf> [accessed 12 July 2013].
- Deltacommissie. 2008. *Working together with water: a living land builds for its future. Findings of the Deltacommissie 2008*. Deltacommissie, The Netherlands. [online]. URL: [http://www.deltacommissie.com/doc/deltareport\\_full.pdf](http://www.deltacommissie.com/doc/deltareport_full.pdf) [accessed 24 May 2012].
- DHS. 2006. *National Infrastructure Protection Plan*. U.S. Department of Homeland Security. [online] URL: [http://www.dhs.gov/xlibrary/assets/NIPP\\_Plan\\_noApps.pdf](http://www.dhs.gov/xlibrary/assets/NIPP_Plan_noApps.pdf) [accessed 15 July 2015].
- DHS. 2009. *National Infrastructure Protection Plan: Partnering to enhance protection and resiliency*. U.S. Department of Homeland Security. [online] URL: [http://www.dhs.gov/xlibrary/assets/NIPP\\_Plan.pdf](http://www.dhs.gov/xlibrary/assets/NIPP_Plan.pdf) [accessed 15 July 2015].
- DHS. 2010. *DHS Risk Lexicon: 2010 edition*. Risk Steering Committee, U.S. Department of Homeland Security. [online] URL: [www.dhs.gov/xlibrary/assets/dhs\\_risk\\_lexicon.pdf](http://www.dhs.gov/xlibrary/assets/dhs_risk_lexicon.pdf) [accessed 19 June 2015].
- DHS. 2011. *National Preparedness Goal*. U.S. Department of Homeland Security. [online] URL: [http://www.fema.gov/media-library-data/20130726-1828-25045-9470/national\\_preparedness\\_goal\\_2011.pdf](http://www.fema.gov/media-library-data/20130726-1828-25045-9470/national_preparedness_goal_2011.pdf) [accessed 15 September 2015].
- DHS. 2013. *NIPP 2013: Partnering for Critical Infrastructure Security and Resilience*. U.S. Department of Homeland Security. [online] URL:

- [http://www.dhs.gov/sites/default/files/publications/NIPP%202013\\_Partnering%20for%20Critical%20Infrastructure%20Security%20and%20Resilience\\_508\\_0.pdf](http://www.dhs.gov/sites/default/files/publications/NIPP%202013_Partnering%20for%20Critical%20Infrastructure%20Security%20and%20Resilience_508_0.pdf) [accessed 15 July 2015].
- DOTARS. 2004. *Natural Disasters in Australia: reforming mitigation, relief and recovery arrangements*. Commonwealth of Australia, Department of Transport and Regional Services, Canberra, Australia.
- Dutch Government. 2006. *Spatial Planning Key Decision: Room for the River. Approved decision 19 December 2006*. Dutch Cabinet, The Netherlands.
- Dutch Government. 2008. *Flood Risk: Understanding Concepts*. Ministry of Transport Public Works and Water Management. [online]. URL: [www.helpdeskwater.nl/publish/pages/4309/waterveiligheid-lowres.pdf](http://www.helpdeskwater.nl/publish/pages/4309/waterveiligheid-lowres.pdf) [accessed 18 August 2015].
- Dutch Government. 2009. *2009 - 2015 National Water Plan*. State Secretary for Transport, Public Works and Water Management and the Ministers for Housing, Regional Development and the Environment and for Agriculture, Nature and Food Quality, The Hague, The Netherlands.
- Dutch Government. 2011. *Summary National Policy Strategy for Infrastructure and Spatial Planning Making the Netherlands competitive, accessible, liveable and safe*. Ministry of Infrastructure and the Environment, The Hague, The Netherlands.
- Dutch Government. 2012. *Room for the River*. Room for the River Programme Directorate, The Netherlands. [online]. URL: <http://www.ruimtevoorderivier.nl/meta-navigatie/english/publications/> [accessed 24 May 2012].
- Dutch Government. 2013. *Climate Agenda: Resilient, Prosperous and Green*. Ministry of Infrastructure and the Environment, The Hague, The Netherlands.
- Dutch Government. 2014. *Delta Programme 2015*. Ministry of Infrastructure and the Environment; Ministry of Economic Affairs. [online]. URL: <http://english.deltacommissaris.nl/delta-programme/documents/publications/2014/09/16/delta-programme-2015> [accessed 12 August 2015].
- Dutch Government. 2015. *Management & Development Plan for National Waters 2016-2021*. Ministry of Infrastructure and the Environment, Rijkswaterstaat. [online]. URL: <http://www.government.nl/ministries/ienm/documents-and-publications/notes/2014/12/23/summary-management-plan-for-national-waters-2016-2021.html> [accessed 23 June 2015].
- EMA. 1998. *Australian Emergency Management Glossary*. Emergency Management Australia, Attorney-General's Department, Canberra, Australia.
- Engel, K., G. Frerks, L. Velotti, J. Warner, and B. Weijs. 2014. Flood disaster subcultures in The Netherlands: The parishes of Borgharen and IJtteren. *Natural Hazards* 73(2):859-882. doi:10.1007/s11069-014-1116-5.
- FEMA. 2015a. *Guidelines for Implementing Executive Order 11988, Floodplain Management, and Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input*. Federal Emergency Management Agency. [online] URL: <http://www.fema.gov/media-library/assets/documents/110377> [accessed 19 October 2015].
- FEMA. 2015b. *Revised Guidelines for Implementing Executive Order 11988, Floodplain Management: DRAFT FOR PUBLIC COMMENT 1/28/2015*. U.S. Federal Emergency Management Agency. [online] URL: <http://www.fema.gov/media-library-data/1422653213069-9af488f43e1cf4a0a76ae870b2dced9/DRAFT-FFRMS-Implementating-Guidelines-1-29-2015r2.pdf> [accessed 15 July 2015].
- FEMA. 2015c. *Federal Flood Risk Management Standard*. US Federal Emergency Management Agency. [online] URL: [http://www.fema.gov/media-library-data/1422649643416-c0ff9e51d11442790ab18bae8dc5df4b/Federal\\_Flood\\_Risk\\_Management\\_Standard.pdf](http://www.fema.gov/media-library-data/1422649643416-c0ff9e51d11442790ab18bae8dc5df4b/Federal_Flood_Risk_Management_Standard.pdf) [accessed 15 July 2015].
- FEMA. 2015d. *Guidelines for Implementing Executive Order 11988, Floodplain Management, and Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input*. Federal Emergency Management Agency. [online] URL: <http://www.fema.gov/media-library/assets/documents/110377> [accessed 19 October 2015].
- GAO. 2015. *Hurricane Sandy: an investment strategy could help the federal government enhance national resilience for future disasters: report to congressional requesters July 2015*. United States Government Accountability Office. [online] URL: <http://www.gao.gov/assets/680/671796.pdf> [accessed 22 September 2015].
- Gao, Y., H. Wang, G. M. Liu, X. Y. Sun, X. Y. Fei, P. T. Wang, T. T. Lv, Z. S. Xue, and Y. W. He. 2014. Risk assessment of tropical storm surges for coastal regions of China. *Journal of Geophysical Research: Atmospheres* 119(9): 5364-5374. doi:10.1002/2013JD021268.



- GEF. 2015. *Tackling Global Environmental Challenges through the Integrated Approach Pilots: report for the GEF Council June – October 2015*. Global Environment Facility. [online] URL: <https://www.thegef.org/gef/sites/thegef.org/files/publication/IAP%20Report%20to%20Council%20LR%20Oct19.pdf> [accessed 26 October 2015].
- Gibbs, L. 2002. *Aesop's Fables: a new translation by Laura Gibbs*. Oxford University Press, Oxford UK.
- Gunderson, L. 2010. Ecological and Human Community Resilience in Response to Natural Disasters. *Ecology and Society* 15(2):18.
- Handmer, J. W., and S. R. Dovers. 1996. A typology of resilience: rethinking institutions for sustainable development. *Industrial and Environmental Crisis Quarterly* 9(4):482-511.
- HM Government. 2010. *A Strong Britain in an Age of Uncertainty: The National Security Strategy*. UK Cabinet Office and National Security and Intelligence, UK. [online] URL: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/61936/national-security-strategy.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/61936/national-security-strategy.pdf) [accessed 18 November 2013].
- Holling, C. S. 1973. Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics* 4:1-23. doi: 10.1146/annurev.es.04.110173.000245.
- HSRTF. 2013. Hurricane Sandy rebuilding strategy. Hurricane Sandy Rebuilding Task Force. [online] URL: <http://portal.hud.gov/hudportal/documents/huddoc?id=hsrebuildingstrategy.pdf> [accessed 15 July 2015].
- Huang, B., G. Ma, and J. Wang. 2013. Resilience strategies for flood risk management in the Netherlands. *Advances in Science and Technology of Water Resources* 33(5):6-10. doi:10.3880/j.issn.10067647.2013.05.002.
- Hudson, P. F., H. Middelkoop, and E. Stouthamer, 2008. Flood management along the Lower Mississippi and Rhine Rivers (The Netherlands) and the continuum of geomorphic adjustment, *Geomorphology* 101(1-2): 209-236. doi:10.1016/j.geomorph.2008.07.001.
- IPCC. 2012. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge and New York.
- IPCC. 2014. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Edited by V. R. Barros, C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White. Cambridge University Press. Cambridge, United Kingdom and New York, NY, USA.
- IPET. 2009. *Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System. Final Report of the Interagency Performance Evaluation Task Force: Volume 1 - Executive Summary and Overview*. Interagency Performance Evaluation Task Force; United States Army Corps of Engineers. [online] URL: <http://biotech.law.lsu.edu/katrina/ipet/Volume%201%20FINAL%2023Jun09%20mh.pdf> [accessed 18 July 2012].
- Jha, A. K., R. Bloch, and J. Lamond. 2012. *Cities and Flooding: a Guide to Integrated Urban Flood Risk Management for the 21st Century*. The World Bank, Washington D.C.
- Jiang, Y., F. K. S. Chan, J. Holden, Y. Zhao, and D. Guan. 2013. China's water management - challenges and solutions. *Environmental Engineering and Management Journal* 12(7):1311-1321.
- Kates, R. W., C. E. Colten, S. Laska, and S. P. Leatherman. 2006. Reconstruction of New Orleans after Hurricane Katrina: A research perspective. *Proceedings of the National Academy of Sciences* 103(40):14653-14660. doi:10.1073/pnas.0605726103.
- Klijn, F., M. Van Buuren, and S. A. M. Van Rooij. 2004. Flood-risk management strategies for an uncertain future: Living with rhine river floods in the Netherlands? *Ambio* 33(3):141-147.
- La Fontaine, J. d. 1880. *Fables de La Fontaine*. Émile Guérin, Librairie Théodore Lefèvre et Cie, Paris.
- Lao Tsu. 1973. *Tao Te Ching - Lao Tsu: a new translation by Gia-fu Feng and Jane English*. Wildwood House, London, UK.
- Lenaghan, R. T. 1967. *Caxton's Aesop*. Harvard University Press, Cambridge, Massachusetts.
- Liao, K.-H. 2012. A theory on urban resilience to floods—a basis for alternative planning practices. *Ecology and Society* 17(4):48. doi:10.5751/ES-05231-170448.
- Lu, M., and J. Lewis. 2015. *China and US Case Studies: Preparing for Climate Change: Shanghai: Targeting Flood Management*. Georgetown Climate Center. [online] URL:

- <http://www.georgetownclimate.org/shanghai-targeting-flood-management> [accessed 28 August 2015].
- Ma, J., X. Tan, and N. Zhang. 2010. Flood management and flood warning system in China. *Irrigation and Drainage* 59:17-22. doi:10.1002/ird.513.
- Matyas, D., and M. Pelling. 2015. Positioning resilience for 2015: the role of resistance, incremental adjustment and transformation in disaster risk management policy. *Disasters* 39:S1–S18. doi:10.1111/disa.12107.
- MCEER. 2006. *MCEER's Resilience Framework*. Multidisciplinary Center for Earthquake Engineering Research, University at Buffalo. [online] URL: [http://mceer.buffalo.edu/research/resilience/Resilience\\_10-24-06.pdf](http://mceer.buffalo.edu/research/resilience/Resilience_10-24-06.pdf) [accessed 15 July 2015].
- Mens, M. J. P., F. Klijn, K. M. de Bruijn, and E. van Beek. 2011. The meaning of system robustness for flood risk management. *Environmental Science and Policy* 14(8):1121-1131. doi:10.1016/j.envsci.2011.08.003.
- Mens, M. J. P., F. Klijn, and R. M. J. Schielen. 2015. Enhancing flood risk system robustness in practice: Insights from two river valleys. *International Journal of River Basin Management* 13(3):297-304. doi:10.1080/15715124.2014.936876.
- Merriam-Webster Dictionary 2016. Merriam-Webster Dictionary. [online] URL: <http://www.merriam-webster.com/dictionary/resilience> [accessed 13 January 2016].
- Molle, F., P. P. Mollinga, and P. Wester. 2009. Hydraulic bureaucracies and the hydraulic mission: Flows of water, flows of power. *Water Alternatives* 2(3):328-349.
- NCLS. 2009. *Recommendations for a National Levee Safety Program: a report to Congress from the National Committee on Levee Safety*. National Committee on Levee Safety. [online] URL: [http://www.leveesafety.org/rec\\_reporttocongress.cfm](http://www.leveesafety.org/rec_reporttocongress.cfm) [accessed 18 July 2012].
- NEAA. 2009. *Roadmap to a climate-proof Netherlands: summary of PBL report 500078001 (in Dutch)*. Netherlands Environmental Assessment Agency, Bilthoven, The Netherlands.
- NEAA. 2011. *Climate Adaptation in the Dutch Delta. Strategic options for a climate-proof development of the Netherlands*. Netherlands Environmental Assessment Agency, The Hague, The Netherlands.
- Nijssen, P. 2012. *Integrated approach for river safety & urban development*. International Water Association World Congress on Water, Climate and Energy, May 14-17 2012, Dublin. [online] URL: [http://keynote.conference-services.net/resources/444/2653/pdf/IWAWCE2012\\_0774.pdf](http://keynote.conference-services.net/resources/444/2653/pdf/IWAWCE2012_0774.pdf) [accessed 24 May 2012].
- NIST. 2008. *Strategic Plan for the National Earthquake Hazards Reduction Program Fiscal Years 2009–2013*. National Institute of Standards and Technology, U.S. Department of Commerce. [online] URL: [http://www.nehrp.gov/pdf/strategic\\_plan\\_2008.pdf](http://www.nehrp.gov/pdf/strategic_plan_2008.pdf) [accessed 15 July 2015].
- NRC. 2011. *National Earthquake Resilience: Research, Implementation, and Outreach*. National Research Council, Washington, D.C.
- NRC. 2012a. *Dam and Levee Safety and Community Resilience: A Vision for Future Practice, National Research Council Committee on Integrating Dam and Levee Safety and Community Resilience*. National Research Council, Washington D.C.
- NRC. 2012b. *Disaster Resilience: A National Imperative*. National Research Council, Washington D.C.
- Olshansky, R. 2013. *Rebuilding after the 2008 Wenchuan Earthquake: An Example of Resilience?* International Association for China Planning 7th Annual Conference, Shanghai, July 1, 2013.
- Oxford Dictionaries. 2015. Oxford Dictionaries. [online] URL: <http://www.oxforddictionaries.com/definition/english/resilience> [accessed 8 December 2015].
- Oxford English Dictionary. 2016. Oxford English Dictionary. [online] URL: <http://www.oed.com/view/Entry/163619?redirectedFrom=resilience> [accessed 13 January 2016].
- Pitt, M. 2008. *Learning lessons from the 2007 floods: an independent review by Sir Michael Pitt: final report*. [online] URL: [http://webarchive.nationalarchives.gov.uk/20100807034701/http://archive.cabinetoffice.gov.uk/pittreview/\\_media/assets/www.cabinetoffice.gov.uk/flooding\\_review/pitt\\_review\\_full%20pdf.pdf](http://webarchive.nationalarchives.gov.uk/20100807034701/http://archive.cabinetoffice.gov.uk/pittreview/_media/assets/www.cabinetoffice.gov.uk/flooding_review/pitt_review_full%20pdf.pdf) [accessed 24 January 2012].
- P.R.C. 2007. *China's national climate change programme*. National Reform & Development Commission, People's Republic of China, Beijing. [online] URL: <http://en.ndrc.gov.cn/newsrelease/200706/P020070604561191006823.pdf> [accessed 27 September 2012].
- P.R.C. 2012. *China's Policies and Actions for Addressing Climate Change*. Information Office of the State Council of the People's Republic of China, Beijing. [online] URL: <http://www.ccchina.gov.cn/WebSite/CCChina/UpFile/File1324.pdf> [accessed 14 July 2015].

- P.R.C. 2015. *Flood Control and Drought Relief in China* [webpage]. Ministry of Water Resources, People's Republic of China. [online] URL: <http://www.mwr.gov.cn/english/fcdrc.html> [accessed 14 July 2015].
- Productivity Commission. 2014. *Natural Disaster Funding Arrangements, Inquiry Report no. 74*. Productivity Commission, Canberra, Australia. [online] URL: <http://www.pc.gov.au/inquiries/completed/disaster-funding/report> [accessed 21 October 2015].
- QFCI. 2012. *Queensland Floods Commission of Inquiry: Final Report*. Queensland Floods Commission of Inquiry, Brisbane, Australia.
- QRA 2011. *Rebuilding a stronger, more resilient Queensland*. Queensland Reconstruction Authority, Queensland Government. [online] URL: <http://www.qldreconstruction.org.au/u/lib/cms/Resilience-doc.pdf> [accessed 6 March 2012].
- QRA. 2012. *Planning for stronger, more resilient floodplains: Part 2 – Measures to support floodplain management in future planning schemes*. The State of Queensland, Queensland Reconstruction Authority. [online] URL: <http://www.qldreconstruction.org.au/u/lib/cms2/resilient-floodplains-part2-full.pdf> [accessed 1 March 2012].
- Queensland Government. 2013. *Information pack for Queensland disaster mitigation and resilience funding available through the Royalties for the Regions, Local Government Floods Response Subsidy, Natural Disaster Resilience Program*. Department of Local Government, Community Recovery and Resilience. [online] URL: <http://www.dsdlp.qld.gov.au/resources/guideline/local-government/2013-14-joint-application-information-package.pdf> [accessed 11 November 2013].
- Queensland Government. 2014a. *Queensland Strategy for Disaster Resilience*. [online] URL: <http://www.dilgp.qld.gov.au/resources/plan/local-government/queensland-strategy-or-disaster-resilience.pdf> [accessed 9 October 2015].
- Queensland Government. 2014b. *State Planning Policy-state interest guideline. Natural hazards,risk and resilience. August 2014*. Department of State Development, Infrastructure and Planning. [online] URL: <http://www.dsdlp.qld.gov.au/resources/guideline/spp/spp-guideline-natural-hazards-risk-resilience.pdf> [accessed 13 October 2014].
- Queensland Government. 2014c. *State Planning Policy July 2014*. Department of State Development, Infrastructure and Planning. [online] URL: <http://www.dsdlp.qld.gov.au/resources/policy/state-planning/state-planning-policy-jul-2014.pdf> [accessed 16 October 2014].
- Queensland Government. 2015. *Community Resilience Fund (CRF) 2015-16 Guidelines*. Department of Infrastructure, Local Government and Planning. [online] URL: <http://www.dilgp.qld.gov.au/resources/guideline/local-government/2015-16-crf-guidelines.pdf> [accessed 14 October 2015].
- Rahmstorf, S. 2010. A new view on sea level rise: has the IPCC underestimated the risk of sea level rise? *Nature Reports Climate Change* 4. doi:10.1038/climate.2010.29.
- Reghezza-Zitt, M., S. Rufat, G. Djament-Tran, A. Le Blanc, and S. Lhomme. 2012. What Resilience Is Not: Uses and Abuses. *Cybergeo: European Journal of Geography: Environment, Nature, Landscape* 621:1-23.
- Richards, E. P. 2010. The United States Smallpox Bioterrorism Preparedness Plan: Rational Response or Potemkin Planning? *William Mitchell Law Review* 36(5): 5179-5222.
- Smith, D. I. 1998. *Water in Australia: resources and management*. Oxford University Press, Melbourne, Singapore.
- Smith, N. R. 2014. *Building resilient cities in China: the nexus between planning and science*. The seventh annual International Association for China Planning conference, Shanghai, 29 June–1 July 2013. *Town Planning Review* 85(1):127-133. doi:10.3828/tp.2014.8.
- Smits, A. J. M., P. H. Nienhuis, and H. L. F. Saeijs. 2006. Changing estuaries, changing views. *Hydrobiologia* 565(1 SPEC. ISS.):339-355. doi:10.1007/s10750-005-1924-4.
- SDR. 2005. *Grand Challenges for Disaster Reduction*. Subcommittee on Disaster Reduction, National Science and Technology Council, Washington, D.C.
- State of Queensland. 2011. *Climate Change: Adaptation for Queensland Issues Paper*. Department of Environment and Resource Management, Brisbane. [online] URL: <http://www.ehp.qld.gov.au/climatechange/pdf/adaptation-issues-paper.pdf> [accessed 1 March 2012].
- State of Victoria. 2012. *Victorian Emergency Management Reform White Paper*. Victorian Government, Melbourne, Australia.
- State of Victoria. 2014a. *Building a climate resilient Victoria: Victorian climate change adaptation plan progress report*. Department of Sustainability and Environment, Melbourne, Australia.

- State of Victoria (2014b) *Draft Victorian Floodplain Management Strategy*. Department of Environment and Primary Industries, Brunswick, Victoria.
- State of Victoria. 2014c. *Natural Disaster Resilience Grants Scheme 2014-2015 projects* [online]. Emergency Management Victoria. [online] URL: <http://fire-com-live-wp.s3.amazonaws.com/wp-content/uploads/2014-15-NDRGS-list-of-successful-applicants.pdf> [accessed 8 October 2015].
- State of Victoria. 2015. *Victorian Emergency Management Strategic Action Plan 2015 - 2018*. State Crisis and Resilience Council; Emergency Management Victoria. [online] URL: [http://fire-com-live-wp.s3.amazonaws.com/wp-content/uploads/EMV\\_Strategic\\_Web1.pdf](http://fire-com-live-wp.s3.amazonaws.com/wp-content/uploads/EMV_Strategic_Web1.pdf) [accessed 8 October 2015].
- The Macquarie Dictionary. 1987. *The Macquarie Dictionary: second revision*. The Macquarie Library Pty Ltd, Macquarie University, Sydney, Australia.
- Tierney, K. 2006. Social inequality, hazards, and disasters. Pages 109-128 in R. J. Daniels, D. F. Kettl, and H. Kunreuther. *On Risk and Disaster: Lessons from Hurricane Katrina*. University of Pennsylvania Press. Philadelphia, USA.
- UNISDR. 2005. *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*. United Nations Inter-Agency Secretariat of the International Strategy for Disaster Reduction. [online] URL: [http://www.unisdr.org/files/1037\\_hyogoframeworkforactionenglish.pdf](http://www.unisdr.org/files/1037_hyogoframeworkforactionenglish.pdf) [accessed 11 December 2013].
- UNISDR. 2009. *Terminology on Disaster Risk Reduction. United Nations International Strategy for Disaster Risk Reduction*. United Nations International Strategy for Disaster Reduction, Geneva, Switzerland.
- UNISDR. 2012. *List of all participating local governments. UNISDR Making cities resilient: my city is getting ready*. [online]. URL: <http://www.unisdr.org/campaign/resilientcities/pdf> [accessed 24 June 2015].
- UNISDR. 2015a. *Sendai Framework for Disaster Risk Reduction 2015 - 2030*. United Nations Office for Disaster Risk Reduction, Geneva, Switzerland.
- UNISDR. 2015b. *Role Models Finder: China: Chengdu: resilient development* [website]. United Nations International Strategy for Disaster Reduction. [online] URL: [http://www.unisdr.org/campaign/resilientcities/cities/index3/#view\\_role\\_model](http://www.unisdr.org/campaign/resilientcities/cities/index3/#view_role_model) [accessed 14 July 2014].
- UNISDR. 2015c. *The Global Assessment Report on Disaster Risk Reduction. Making Development Sustainable: The Future of Disaster Risk Management*. United Nations Office for Disaster Risk Reduction, Geneva, Switzerland.
- USACE. 2013. *Coastal Risk Reduction and Resilience*. Directorate of Civil Works, US Army Corps of Engineers., Washington, D.C.
- van Slobbe, E., H. J. de Vriend, S. Aarninkhof, K. Lulofs, M. de Vries, and P. Dircke. 2013. Building with Nature: In search of resilient storm surge protection strategies. *Natural Hazards* 65(1):947-966. doi:10.1007/s11069-012-0342-y.
- Vis, M., F. Klijn, K. de Bruijn, and M. van Buuren. 2003. Resilience strategies for flood risk management in the Netherlands. *International Journal of River Basin Management* 1(1):33-40. doi:10.1080/15715124.2003.9635190.
- Walker, B., C. S. Holling, S. R. Carpenter, and A. Kinzig. 2004. Resilience, Adaptability and Transformability in Social-ecological Systems. *Ecology and Society* 9(2):5.
- Walker, B., and D. Salt. 2006. *Resilience Thinking: sustaining ecosystems and people in a changing world*. Island Press, Washington, Covelo, London.
- WB and GFDRR. 2013. *Building Resilience: Integrating Climate and Disaster Risk into Development*. The World Bank and the Global Facility for Disaster Risk Reduction, Washington D.C.
- Weieriks, K., and N. Vlaanderen. 2015. Water-related disaster risk reduction: time for preventive action! Position paper of the High Level Experts and Leaders Panel (HELP) on water and disasters. *Water Policy* 17:212-219. doi:10.2166/wp.2015.011.
- Wenger, C. 2013. *Climate Change Adaptation and Floods: Australia's institutional arrangements*. National Climate Change Adaptation Research Facility, Gold Coast, Australia.
- Wenger, C. 2015a. Better use and management of levees: reducing flood risk in a changing climate. *Environmental Reviews* 23:240-255. doi:10.1139/er-2014-0060.
- Wenger, C. 2015b. Building walls around flood problems: the place of levees in Australian flood management. *Australian Journal of Water Resources* 19(1): 3-30. doi:10.7158/13241583.2015.11465453.
- White House. 2010. *National Security Strategy May 2010*. [online] URL: [https://www.whitehouse.gov/sites/default/files/rss\\_viewer/national\\_security\\_strategy.pdf](https://www.whitehouse.gov/sites/default/files/rss_viewer/national_security_strategy.pdf) [accessed 27 August 2015].

- White House. 2011. *Presidential Policy Directive / PPD-8: National Preparedness*. United States President, The White House, Office of the Press Secretary. [online] URL: <http://www.dhs.gov/xlibrary/assets/presidential-policy-directive-8-national-preparedness.pdf> [accessed 15 July 2015].
- White House. 2013a. *Executive Order - Preparing the United States for the Impacts of Climate Change*. United States President, The White House, Office of the Press Secretary. [online] URL: <https://www.whitehouse.gov/the-press-office/2013/11/01/executive-order-preparing-united-states-impacts-climate-change> [accessed 15 July 2015].
- White House. 2013b. *Presidential Policy Directive/PPD-21 - Critical Infrastructure Security and Resilience*. The White House, Office of the Press Secretary. [online] URL: <https://www.whitehouse.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil> [accessed 15 July 2015].
- White House. 2013c. *The President's Climate Action Plan*. [online]. URL: <https://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf> [accessed 24 August 2015].
- White House. 2014. *Executive Order: Climate-Resilient International Development*. [online] URL: <https://www.whitehouse.gov/the-press-office/2014/09/23/executive-order-climate-resilient-international-development> [accessed 15 July 2015].
- White House. 2015. *Executive Order 13690 – Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input, 30 January 2015*. The White House. [online] URL: <https://www.whitehouse.gov/the-press-office/2015/01/30/executive-order-establishing-federal-flood-risk-management-standard-and-> [accessed 15 July 2015].
- Wolsink, M. 2006. River basin approach and integrated water management: Governance pitfalls for the Dutch Space-Water-Adjustment Management Principle. *Geoforum* 37(4):473-487. doi:10.1016/j.geoforum.2005.07.001.
- Wright, J. M. 2000. *The Nation's Responses to Flood Disasters: a historical account*. Association of State Floodplain Managers, Madison, Wisconsin, USA.
- Xiao, L., X. Fang, Y. Zhang, Y. Ye, and H. Huang. 2014. Multi-stage evolution of social response to flood/drought in the North China Plain during 1644–1911. *Regional Environmental Change* 14:583-595. doi:10.1007/s10113-013-0516-5.
- Yohe, G. and R. S. J. Tol. 2002. Indicators for social and economic coping capacity: moving toward a working definition of adaptive capacity. *Global Environmental Change* 12(1): 25-40.
- Zevenbergen, C., S. van Herk, J. Rijke, P. Kabat, P. Bloemen, R. Ashley, A. Speers, B. Gersonius, and W. Veerbeek. 2013. Taming global flood disasters. Lessons learned from Dutch experience. *Natural Hazards* 65: 1217-1225. doi:10.1007/s11069-012-0439-3.
- Zhang, H.-L., and K. Wen. 2001. *Flood control and management for large rivers in China*. Workshop on Strengthening Capacity in Participatory Planning and Management for Flood Mitigation and Preparedness in Large River Basins: Regional Cooperation in Flood Control and Management in Asia and the Pacific, Phase II, Bangkok, 20-23 November 2001.