

## Syllabus

## Resilience and risk in a changing climate

Instructor: Professor Jacqueline McGlade

[https://en.wikipedia.org/wiki/Jacqueline\\_McGlade](https://en.wikipedia.org/wiki/Jacqueline_McGlade)

Tuesday – Thursday, April 3 - 5  
Monday – Wednesday, April 9 - 11

### Course Description

In this course, students will learn about resilience and risk and how these concepts are shaping today's thinking about our future ability to live sustainably in the face of a changing climate. The course is designed to be highly interactive and is built around lectures, discussion, practical and analytical exercises designed to help students explore how to identify resilience and increase its role, along with risk in policy-making. The course stresses the transdisciplinary nature of resilience and risk in environmental management, the different sciences needed to define options for action, the co-production of knowledge and participatory practices in governance and data gathering. Students will work together in teams and individually to conduct research using case studies aimed at building a theory of change, testing assumptions, identifying uncertainties and developing policy pathways that build resilience and/or are risk-based. Emphasis will be placed on accessing data sources and learning how to use information from a wide variety of sources including earth observation, social media, national surveys and international policy reports.

### *Background concepts*

Resilience is a concept concerned fundamentally with how a system, community or individual can deal with disturbance, surprise and change. It has a strong personal dimension as well as framing current thinking about sustainable futures in an environment of growing risk and uncertainty. Resilience has emerged as a fusion of ideas from multiple disciplinary traditions including ecosystem stability (Holling, 1973; Gunderson, 2009), engineering infrastructure (Tierney and Bruneau, 2007), psychology (Lee et al., 2009), the behavioural sciences (Norris, 2011) and disaster risk reduction (Cutter et al., 2008). Its recent appropriation by bilateral and multilateral donor organisations is a clear example of how resilience is evolving from theory into policy and practice (Bahadur et al., 2010; Brown, 2011; Harris, 2011; HERR, 2011; Ramalingam, 2011).

Risk is a concept long used by the insurance industry and policy makers to alert society about the likelihood of unwanted events. It is used in everyday language to mean "chance of disaster", and when used in a risk assessment it is commonly accepted as being "The combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence" (Royal Society, 1992). Along with risk comes the term hazard, commonly defined as "the potential to cause harm" or "a property or situation that in particular circumstances could lead to harm" (Royal Society, 1992). For example, a large number of chemicals have hazardous properties, but the same acid is only a risk to human health if humans are exposed to it. Risk is estimated by incorporating a measure of the likelihood of the hazard actually causing harm and a measure of the severity of harm in terms of the consequences to people or the environment. There has been a gradual move in environmental policy and regulation from hazard-based to risk-based approaches. This is partly due to the recognition that for many environmental issues a level of zero risk is unobtainable or simply not necessary for human and environmental protection and that a certain level of risk in a given scenario is deemed "acceptable" after considering the benefits.

## **Class Schedule (Each class is 2 hours)**

### **Class 1 Introduction**

We will examine how the concepts of risk and resilience have become embedded in today's environmental and climate policies and science. The materials and interactions will enable students to appreciate the positive and negative sides of resilience, the potential dangers of aligning resilience with risk and the windows of opportunity for change based on resilience thinking (Leach 2008; Birkman et al., 2010; Cannon and Muller-Mahn, 2010: 623; Gaillard, 2010; Jones et al 2010; Brown 2011; IPCC 2011).

**Class exercise - Apps and data:** Each student will select one option and then work in a team, produce a short report or presentation

Option 1) How to detect resilience in ecological data

Option 2) Building a Climate Preparedness Task Force

**Case studies:** each students will be asked to select a case study and then discuss different and present aspects of resilience and risk as a team for the two case-studies

#### **A) California forest fires**

Ramona <http://www.sandiegouniontribune.com/ramona-sentinel/sdrs-lessons-from-2003-2007-wildfires-2012oct17-story.html>

Ramona Air Attack Base <https://www.facebook.com/pages/Ramona-Air-Attack-Base/360586360656838>

Cal Fire <http://frap.fire.ca.gov/> Impacts of drought <http://frap.fire.ca.gov/projects/DroughtViewer>

Tree Mortality <http://egis.fire.ca.gov/TreeMortalityViewer/>

#### **B) Rift Valley, Kenya**

Course challenge: Insuring yourself: personal responsibility and social security

Drought and security <http://www.dw.com/en/drought-worsens-insecurity-in-kenyas-rift-valley/a-37767240>

Food security and vegetation <https://www.pri.org/stories/2017-04-14/drought-conditions-worsen-famine-looms-over-kenya>

**Overall course challenge:** Students will be asked to set out a class challenge that compares the benefits and challenges to society and ecosystems of adopting a resilience-based versus a risk-based approach to future living in a changing climate

#### **Further reading and viewing:**

How to build resilience <https://www.theguardian.com/teacher-network/2016/jan/12/science-resilience-how-to-teach-students-persevere>

Resilience <https://www.sciencedirect.com/science/article/pii/S0891524516302541>

Resilience thinking: sustaining ecosystems and people in a changing world Brian Walker, and David Salt ISBN-13:978-1597260930

Lessons from Sandy: Federal policies to Build climate-resilient coastal regions (Policy Focus Reports)  
2014 Robert Pirani and Laura Tolkoﬀ

TEDx Jacqueline McGlade on Building resilience to face today's challenges – indigenous peoples  
<https://www.youtube.com/watch?v=rLaJFzUWsPM>

### **Classes 2 -3 Our Planet**

We will examine changes on planet earth as seen from space, and in the oceans, terrestrial and aquatic environments. We will also overview results from International Environmental agreements and Global Science Programmes.

This classes will focus on data and information publically available and students will be shown how to find and use the data to infer what is happening. The aim of the class is to build a Theory of Change to underpin environmental and sustainable development policies.

**Class exercise - using Apps and data:** Each student is to select one option and then work in a team to produce a short report or presentation

Option 1) Using satellite earth observations in support of the sustainable development goals

Option 2) What can international agreements tell us about the changing climate?

**Practical exercise** – designing a data-cube for futures planning

**Case studies:** students will be asked to present and discuss different aspects of resilience and risk in the two case-studies

#### **A) The growing threat of marine plastics = do we have enough evidence to act?**

UN Environment <https://www.unenvironment.org/news-and-stories/story/marine-plastic-new-and-growing-threat-coral-reefs>

Foresight Future of the Sea <https://www.gov.uk/government/publications/future-of-the-sea--2>

The problem with plastic <https://www.ft.com/content/30b30b1e-004a-11e8-9650-9c0ad2d7c5b5>

Are you in a toxic relationship? <https://www.unenvironment.org/news-and-stories/video/are-you-toxic-relationship>

#### **B) Wildlife conservation – which route to take authorised hunting or banning?**

Wildlife Works <http://www.wildlifeworks.com/>

African Wildlife Auctions <https://www.awla.co.za/>

The last northern white rhino dies <https://news.nationalgeographic.com/2018/03/northern-white-rhino-male-sudan-death-extinction-spd/>

Can trophy hunting help conservation? <http://www.conservationmagazine.org/2014/01/can-trophy-hunting-reconciled-conservation/>

Hong Kong bans ivory trade <http://www.bbc.com/news/world-asia-china-42891204>

**Contribution to the course challenge:** As part of the course challenge, students will be asked to evaluate an environmental campaign of their choice to see how it can create awareness and opportunities for tackling environmental degradation

### Further reading:

European Space Agency and Committee on Earth Observation Satellites Satellite Earth Observations in support of the Sustainable Development Goals

[http://eohandbook.com/sdg/files/CEOS\\_EOHB\\_2018\\_SDG.pdf](http://eohandbook.com/sdg/files/CEOS_EOHB_2018_SDG.pdf)

UN Environment <https://www.unenvironment.org/resources/report/towards-pollution-free-planet-report-executive-director>

### Class 3-4 Peace, Justice and Equity

In this class we will look at climate justice; climate related conflict and displacement; resilience and risk in terms of prosperity and well-being; and gender related impacts of climate change.

Today we have come to consider the protection of citizens as a cornerstone of governmental responsibility. In the context of climate change, this includes devising mitigation, protection and preparation strategies to address the increasingly frequent and severe incidence of extreme events such as storm surges and flash flooding as well as slow-onset threats such as drought and sea-level rise. There is now a greater awareness that the selection and implementation of adaptation options has ethical implications due to the potential for inequitable distribution of costs and benefits (Klein et al. 2014). Demands for fairness and justice are now being made by governments and civil society alike due to the fact that many of the resulting negative impacts affect the most vulnerable in society and those with least historical responsibility for climate change. In the context of climate change, discussions are challenged by the need to consider future generations and accommodate inherent uncertainties. This suggests the need for formulating new social contracts based on principles of distributive and procedural justice that are flexible enough to accommodate and give voice to present and future vulnerable groups in order to ensure resilient social-ecological systems.

There is also a growing recognition of the contributions that local knowledge can make to the success of adaptation interventions and of the wisdom that indigenous and traditional knowledge systems harbour about the environment (Berkes et al. 2000). Preferential use of one type of knowledge over another, is on the one hand unjust and, on the other, promotes paradigms that may in fact be damaging to the environment as well as vulnerable social groups (e.g. through the use of economic cost-benefit assessments as a sole or central deciding factor in the planning of climate adaptation interventions). In this sense, defining effective and equitable or fair responses to climate adaptation should arguably rely on the incorporation of multiple knowledge systems and a critical examination of the role that language and discourse play in perpetuating injustices.

**Class exercise - evidence:** Students are asked to consider one of four aspects of justice and fairness and find evidence to support their arguments:

a) unequal responsibilities: who bears greater responsibility for GHG emissions? b) unequal impacts of climate change: Who is more adversely affected by the extreme weather events that are predicted to increase in frequency and intensity? c) unequal impacts of policy responses: Who benefits from and who bears the costs and burdens of mitigation and adaptation policy? and d) procedural justice: Who has the power to make and affect policy responses to climate change?

**Practical exercise** – becoming a climate refugee

**Case studies:** students will be asked to present and discuss different aspects of justice and fairness in the two case-studies as they relate to resilience and risks in managing people and wildlife

## **A) Climate Refugees – who is responsible for their future and do we need a new international agreement?**

What makes a climate refugee? <https://www.undispatch.com/climate-refugees-explained/>

Are hurricanes creating climate refugees?

<https://www.forbes.com/sites/marshallshepherd/2017/09/21/are-hurricanes-creating-climate-refugees-in-the-caribbean/#6bf2722c5e97>

## **B) The Northern Rocky Mountains, Yellowstone Park and the Introduction of gray wolves**

Gray Wolves <https://www.justice.gov/enrd/northern-rocky-mountain-gray-wolves>

Yochim, M. (2013) Protecting Yellowstone: Science and the Politics of National Park Management Hardcover University of New Mexico Press

Robbins, P. 2006. The politics of barstool biology: Environmental knowledge and power in greater Northern Yellowstone. *Geoforum* 37(2): 185-199.

**Contribution to the course challenge:** As part of the course challenge, students will be asked to evaluate the importance of fairness, equity and justice in developing resilience and risk-based approaches to future sustainability, especially with respect to issues of re-insurance

### **Further reading:**

Abdul Malak, D., McGlade, K., Pascual, D. and Pia, E (2017) Adapting to climate change: An Assessment of Vulnerability and Risks to Human Security in the Western Mediterranean Basin. Springer Briefs in Environmental Science. <http://www.springer.com/gp/book/9783319516783>

Bell, D. and Rowe, F., 2012. Are climate policies fairly made? Joseph Rowntree Foundation. York.

Berkes, F., J. Colding, and C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications* 10:1251–1262.

Dietz, B. and D. O'Neill (2013) Enough is enough: building a sustainable economy in a world of finite resources. Berret-Koehler Publishers, California

<https://www.bkconnection.com/books/title/enough-is-enough>

Klein, R.J.T., G.F. Midgley, B.L. Preston, M. Alam, F.G.H. Berkhout, K. Dow, and M.R. Shaw. 2014. Adap-tation opportunities, constraints, and limits. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerabil-ity. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, 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 (eds.)]. Cambridge University Press, Cam-bridge, United Kingdom and New York, NY, USA, pp. 899-943.

Lindley, S., O'Neill, J., Kandeh, J., Lawson, N., Christian, R. and O'Neill, M. 2011. Climate change, justice and vulnerability. Joseph Rowntree Foundation. York.

Sandel, Michael J. 2009. Justice: what's the right thing to do? New York: Farrar, Straus and Giroux.

Schlosberg, D. and Collins, L. B. 2014. From environmental to climate justice: climate change and the discourse of environmental justice. WIREs Clim Change, 5: 359–374.

Wilkinson, R. and K. Pickett (2010) The Spirit Level. Why equality is better for everyone. Penguin Books. <https://www.penguin.co.uk/books/179241/the-spirit-level/>

## **Classes 5 -6 Innovation and Climate Mitigation**

In the next classes, students will look at carbon management, geoengineering, the emergence of new materials and climate smart cities. We will also look at different ideas from the perspective of resilience and risk and mobilizing the co-benefits of climate change mitigation, including: technological options for the future of continental-scale grids, concentrated solar power, solar radiation management, and carbon dioxide removal.

The uses of geoengineering as proposed responses to climate change will be looked at to gain a greater understanding of the likelihood of reductions in greenhouse gas emissions, potential scenarios, societal issues such as the political dimensions of deployment, the likely costs and benefits, environmental responsibility and public perception, consultation and awareness.

**Class exercise - evidence:** Students are asked to put together a set of slides (4-5) depicting the basis of one technique that is directed towards either greenhouse gas removal (such as afforestation, biochar, direct air capture, enhanced weathering and increased ocean alkalinity, enhancing physical oceanic carbon uptake, carbon dioxide storage) or albedo modification (such as stratospheric aerosol injection, marine cloud brightening, desert /vegetation reflectivity modification, cirrus cloud thinning), the moral hazards and their likely success.

**Practical exercise:** designing an app for carbon management

**Case studies:** students will be asked to present and discuss how the technologies they have heard about would help reduce greenhouse gas emissions, what it would mean personally as well as how they support resilience and risk reduction

### **A) Autonomous vehicles – what does it mean for our cities**

World Atlas of Cities getting ready for autonomous Vehicles <https://avsincities.bloomberg.org/>

Driverless cars and city building <https://www.youtube.com/watch?v=R1B9z8ituS8>

### **B) Novel foods – would you consume them?**

Novel foods <https://www.food.gov.uk/science/novel>

Novel foods [https://ec.europa.eu/food/safety/novel\\_food\\_en](https://ec.europa.eu/food/safety/novel_food_en)

**Course challenge:** Student teams will examine how a range of new and recycled materials can be used in the design of climate resilient urban communities and cities.

### **Further reading on geoengineering:**

Aaheim, A. et al (2015) An economic evaluation of solar radiation management. *Science of the Total Environment* 532:61-69

Bellamy, R. et al (2013) opening up geoengineering appraisal: multi-criteria mapping of options for tackling climate change. *Global Environmental Change* 23:926-937

Bickel, J.E. and Agrawal, S. (2013) Re-examining the economics of aerosol geoengineering. *Climate Change* 119:993-1006

Blain, S. et al (2007) Effect of natural iron fertilization on carbon sequestration in the Southern Ocean. *Nature* 446: 1070-1074

Caney, S. (2010) Climate change and the duties of the advantaged. *Critical Review of International Social and Political Philosophy* 13: 203-228

Hulme, M. (2014) *Can science fix climate change. A case against climate engineering.* Cambridge Polity Press

Joronen, S. et al (2011) Towards weather ethics: from chance to choice with weather modification. *Ethics, Policy and Environment* 14: 55-67

Tedsen, E. and Homann G. (2013) Implementing the precautionary principle for climate engineering. *Carbon and Climate Law Review* 90-100

### **Classes 7 -8 Emerging futures and risks**

In these final classes, we will examine the different development pathways that have been set out by the international community, such as the Sustainable Development Goals and the Sendai Framework, and examine to what extent they are likely to enhance resilience, reduce risks and encourage prosperity and well-being in the face of a changing climate. In the first class we will look at sustainable development and climate related impacts especially on women and children, with a focus on the continent of Africa.

We will then go on to look at emerging and ongoing risks that have the potential to derail these trajectories; issues such as climate-related displacement, the spread of aflatoxins in crops and the impact on food security, rapid sea-level rise from extensive melting of the ice-caps and the impact on coastal communities and urban areas, the spread of wildlife zoonoses and the impacts on public health, and nanotechnology and the impacts on manufacturing and emissions.

**Class exercise – visualisation:** students are asked to visualise a future scenario for their favoured location, taking into account the possible emerging risks that might alter the current trajectory of social, environmental and economic development

**Practical exercise** – establishing a resource centre during a climate related natural disaster

**Case studies:** Students are asked to evaluate one of the two case studies from the perspective of building resilience and gender sensitivity into a sustainable futures strategy

#### **A) Zurich Re – Flood Resilience**

Measuring resilience in the face of climate change

<https://zurich.com/en/corporate-responsibility/flood-resilience>

## **B) Caribbean Development Bank – Climate Resilience Strategy**

[http://www.caribank.org/wp-content/uploads/2016/03/BD23\\_12Rev1TA-Paper\\_Climate-ResilienceStrategy\\_FINAL.pdf](http://www.caribank.org/wp-content/uploads/2016/03/BD23_12Rev1TA-Paper_Climate-ResilienceStrategy_FINAL.pdf)

**Course challenge:** Student teams are expected to complete and present their course challenge, drawing on materials from the classes, practical experiences, case studies and class exercises, setting out the benefits and challenges to society and ecosystems of adopting a resilience-based versus a risk-based approach to future living in a changing climate.

### **Further reading and viewing:**

Abel, G.J. et al. (2016) Meeting the sustainable goals leads to lower population growth  
<http://www.pnas.org/content/113/50/14294.full>

European Environment Agency (2013) Late lessons from early warnings: science, precaution, innovation. Copenhagen <https://www.eea.europa.eu/publications/late-lessons-2>

NRDC (2017) <https://www.nrdc.org/stories/how-climate-change-impacts-women>

UN Department of Economic and Social Affairs  
<https://sustainabledevelopment.un.org/content/documents/3485DESA-20032013.pdf>

United Nations Environment Programme (2016, 2017) Frontiers 2016 and Frontiers 2017 – emerging issues of environmental concern <https://www.unenvironment.org/resources/frontiers-2016-emerging-issues-environmental-concern> <https://www.unenvironment.org/resources/frontiers-2017-emerging-issues-environmental-concern>

World Health Organization (2014) Gender, Climate Change and Health, Geneva.  
[http://www.who.int/globalchange/publications/reports/gender\\_climate\\_change/en/](http://www.who.int/globalchange/publications/reports/gender_climate_change/en/)

### **Some additional background literature on Resilience and Risk**

Bahadur, A. V., Ibrahim, M., & Tanner, T. (2010) The resilience renaissance? Unpacking of resilience for tackling climate change and disasters. Institute of Development Studies (for the Strengthening Climate Resilience (SCR) consortium): Brighton, UK

Berkes, F. (2007) Understanding uncertainty and reducing vulnerability: Lessons from resilience thinking, *Natural Hazards* 41: 283–295.

Birkmann, J., Buckle, P., Jaeger, J., Pelling, M., Setiadi, N., Garshagen, M., Fernando, N. and Kropp, J. (2010) Extreme Events and Disasters: a window of opportunity for change? Analysis of organisational, institutional and political change, formal and informal responses after mega-disasters. *Natural Hazards*, 55(3)

Brown, K. (2011) Rethinking progress in a warming world: Interrogating Climate Resilience Development. Rethinking Development in an Age of Scarcity and Uncertainty' EADI/DSA Conference, York, September 2011.

- Cannon, T., and Muller-Mahn D. (2010) Vulnerability, resilience and development discourses in context of climate change. *Natural Hazards*, 55:621-635.
- Carpenter, S., Walker, B., Anderies, J. And Abel, N. (2001) From Metaphor to Measurement: Resilience of What to What? *Ecosystems*, 4: 765-781.
- Conway, G., Waage, J.K., Delaney, S. (2010) *Science and Innovation for Development*. UK Collaborative on Development Science. UKCDS: Hampshire, UK
- Cutter, S.L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., and Webb, J., (2008) A place-based model for understanding community resilience to natural disasters. *Global Environmental Change*, 18(4): 598-606.
- Davies, S., (1993) Are coping strategies a cop out? *Institute of Development Studies Bulletin*, 24 (4): 60-72. Institute of Development Studies: Brighton, UK
- DFID (2011) *Defining Disaster Resilience: A DFID Approach Paper*. DFID 2011. UK Department for International Development: London
- Devereux and Sabates-Wheeler (2004) *Transformative social protection*. Institute of Development Studies Working Paper 232. Institute of Development Studies: Brighton, UK
- Eriksen, S.H. and Kelly, P.M. (2007) Developing credible vulnerability indicators for climate adaptation policy assessment. *Mitigation and Adaptation Strategies for Global Change*, 12: 495-524.
- Folke, C., (2006) Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change*, 16(3): 253-267.
- Foresti, M., Massa, I., Wild, L. And Harris, D. (2011) Responding to external economic shocks: why state capacity and political incentives matter. ODI Project Briefing, No. 54. January 2011. Overseas Development Institute: London
- Galliard, J.C. (2010) Vulnerability, capacity and resilience: perspectives for climate and development policy. *Journal of International Development* 22: 218-232.
- Gunderson, L., (2009) *Comparing Ecological and Human Community Resilience*. CARRI Research Paper, 5, Community and Regional Resilience Initiative, National Security Directorate: Oak Ridge, TN, 35 pp.
- Harris, K. (2011) *Resilience in Practice: Operationalising the Ten Characteristics of Resilience through the Case of Greening Darfur*. Strengthening Climate Resilience Discussion Paper 10, Institute of Development Studies: Brighton
- HERR (2011) *Humanitarian Emergency Response Review*. 28th March 2011. Chaired by Lord (Paddy) Ashdown. Humanitarian Emergency Response Review, DFID. UK Department for International Development: London
- Holling, C. S., (1973) Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics*, 4: 1-23.
- IPCC, (2011) *Special Report on Managing the Risks of Climate Extremes and Disasters to Advance Climate Change Adaptation*. IPCC November 2011. IPCC: Geneva. Available online: <http://www.ipcc.ch>

- Jones, L., Ludi, E., Levine, S. (2010) Towards a characterisation of adaptive capacity: a framework analysing adaptive capacity at the local level. ODI Background Notes, December 2010. Overseas Development Institute: London
- Leach, M. (Ed.) (2008) Re-framing Resilience: a Symposium Report. STEPS working paper 13. STEPS Centre: Brighton
- Lee, E.K.O., Shen, C., and Tran, T.V., (2009) Coping with Hurricane Katrina, psychological stress and resilience among African Americans evacuees. *Journal of Black Psychology*, 35(1): 5-23.
- Manyena, S. B. (2006) The concept of resilience revisited. *Disasters*, 30(4): 433-450. *Disasters Journal*. Overseas Development Institute: London
- Manyena, S. B., O'Brien, G., O'Keefe, P., Rose, J. 2011. Disaster resilience: a bounce back or bounce forward ability? *Local Environment*, 16(5): 417-424.
- McGray, H., Hammill, A., Bradley, R., Schipper, L., and Parry, J. (2008) *Weathering the storm: Options for framing adaptation and development*. World Resources Institute: Washington DC.
- Norris, F.H., Stevens, S.P., Pfefferbaum, B., Wyche K.F., Pfefferbaum, R. L. (2008) Community Resilience as a Metaphor, Theory, Set of Capacities, and Strategy for Disaster Readiness. *American Journal of Community Psychology* 41: 127–150.
- Norris, F., (2011) *Behavioural Science Perspectives on Resilience*. CARRI Research Paper, 11, Community and Regional Resilience Institute Oak Ridge: Tennessee, USA, 50 pp.
- Obrist, B., Pfeiffer, C., and Henley, R., (2010) Multi-layered social resilience: a new approach in mitigation research. *Progress in Development Studies*, 10(4): 283-293.
- Prior, Tim; Hagmann, Jonas (2014) Measuring Resilience. *Journal of Risk Research* 17, 281-298.
- Silva Villanueva, P. (2011) *Learning to ADAPT: monitoring and evaluation approaches in climate change adaptation and disaster risk reduction – challenges, gaps and ways forward*. Strengthening Climate Resilience Discussion Paper 9. Institute of Development Studies: Brighton.
- Tierney, K. and Bruneau, M., (2007) *Conceptualizing and Measuring Resilience: A Key to Disaster Loss Reduction*. TR News 250, May-June 2007, 14-17. Available online: [http://onlinepubs.trb.org/onlinepubs/trnews/trnews250\\_p14-17.pdf](http://onlinepubs.trb.org/onlinepubs/trnews/trnews250_p14-17.pdf)
- Twigg, J. (2009) *Characteristics of a Disaster-Resilient Community. A Guidance Note. Version 2*. November 2009. DFID Disaster Risk Reduction Interagency Coordination Group. UK Department for International Development: London
- UNISDR (2011) *Global Assessment Report on Disaster Risk Reduction: Revealing Risk, Redefining Development*, United Nations International Strategy for Disaster Reduction.