

Towards a characterisation of adaptive capacity: a framework for analysing adaptive capacity at the local level

By Lindsey Jones, Eva Ludi and Simon Levine

Interest is growing in supporting vulnerable people and communities to adapt to the impacts of a changing climate, and there is a general assumption that there are close links between development and adaptation. Yet our understanding of the impacts that development interventions have on adaptive capacity at the local level remains limited. Most development interventions are not designed with a climate change ‘adaptation’ label, but it is likely that they influence communities’ capacity to adapt to changing shocks and trends – whether as a result of climate change or other pressures associated with development (see Jones et al., 2010).

A framework for understanding and assessing adaptive capacity *at the local level* is needed to begin to understand how it can be supported through wider development processes at both local and national levels. Such a framework may in time serve as a platform to monitor progress, identify needs and allocate development resources to enhance a system’s ability to adapt to change.

Why another framework?

Traditional frameworks to conceptualise adaptive capacity, both at national and local levels, have focused largely on assets and capitals as indicators (Brooks et al., 2005; Dulal et al., 2010). While useful in helping us to understand the resources at the disposal of a system – a nation, a community or a household – to cope with and adapt to changing environments, asset-oriented approaches typically mask the role of processes and functions in supporting adaptive capacity.

Understanding adaptive capacity, therefore, entails recognising the importance of various intangible processes: decision-making and governance; the fostering of innovation, experimentation and opportunity exploitation; and the structure of institutions and entitlements, for example. Doing this requires moving away from simply looking at what a system *has* that enables it to adapt, to recognising what a system *does* to enable it to adapt (WRI, 2009).

The framework presented here has many similarities with others, but it gives greater attention to processes, rather than snapshot pictures of a system at a single point in time. As with all frameworks, the idea is not to claim a greater truth in reflecting reality than other frameworks, but rather to be as useful as

The **Overseas Development Institute** is the UK’s leading independent think tank on international development and humanitarian issues. **ODI Background Notes** provide a summary or snapshot of an issue or of an area of ODI work in progress. This and other ODI Background Notes are available from www.odi.org.uk

The **Africa Climate Change Resilience Alliance (ACCRA)** is a consortium working to increase governments’ and development actors’ use of evidence in designing and implementing both humanitarian and development interventions that increase poor and vulnerable communities’ adaptive capacity. Consortium partners include ODI, CARE, Oxfam GB, Save the Children and World Vision. For more information visit <http://community.eldis.org/accra/>



possible – specifically, in this case, to those who are looking at how internal and external factors change local adaptive capacity, to make it easier for users to see and to reflect on important dimensions that might otherwise be neglected.

This Background Note puts forward a ‘Local Adaptive Capacity framework’ (LAC) developed as part of the Africa Climate Change Resilience Alliance (ACCRA) programme, drawing on extensive consultations with academics, policy-makers and practitioners. It is an attempt to incorporate intangible and dynamic dimensions of adaptive capacity, as well as capitals and resource-based components, into an analysis of adaptive capacity at the local level.

The framework forms the conceptual basis for ACCRA’s country-level research, which seeks to understand how development or social protection interventions undertaken by ACCRA members, namely, Oxfam, Save the Children, World Vision and CARE contribute to adaptive capacity in 11 communities in three African countries, Uganda, Mozambique and Ethiopia. It starts by recognising that it is currently *not feasible to measure adaptive capacity directly*. Instead, LAC is based on an analysis of the characteristics that contribute to the adaptive capacity of a system. These characteristics are identified and further analysed in consultation with practitioners and academics, building on existing literature.

The focus of LAC is currently on systems at ‘local’ level, recognising that, while much of the attention has so far been given to developing characteristics and indicators at the national level, little research and analysis has been done on adaptive capacity at the community or household levels. The framework lays out five *distinct yet interrelated* characteristics of adaptive capacity, with the underlying assumption that positive impacts on these characteristics should enhance the system’s adaptive capacity. In time it is hoped that tools will be developed that may allow this assumption to be tested, and, as understanding of adaptive capacity and ways to monitor it are developed through research, that it will be possible to adapt and improve the LAC.

From adaptation to adaptive capacity

At the heart of any local-level adaptation intervention is the need to increase the individual or community’s adaptive capacity. There is still much debate around the definition and practical applications of the term adaptive capacity. Broadly speaking, adaptive capacity denotes the ability of a system to adjust, modify or change its characteristics or actions to moderate potential damage, take advantage of opportunities or cope with the consequences of shock or stress

(Brooks, 2003). A key component of this is ensuring that individuals, communities and societies are actively involved in processes of change (Pettengell, 2010). Importantly, this relates to changes in behaviour, as well as in resources and technologies.

Although the immediate application of this framework within ACCRA has been to look at adaptive capacity to climate change, the framework is designed to look at change generally, and may be applicable in other contexts of changing shocks and trends. With this in mind, the characteristics of a system with a high capacity to adapt to a changing climate may largely overlap with those of a system that is resilient to wider external shocks and trends.

A framework designed exclusively to look at local capacity to deal with the impacts of climate change would be of doubtful practical utility, as a community’s ability to respond to climate change depends, at least in part, on underlying drivers of poverty and vulnerability (e.g. levels of economic resources and the effectiveness and flexibility of local institutions), and on factors that both influence and are highly influenced by them (e.g. the willingness of a community to innovate). Moreover, it is seldom the case that adaptation action will be taken in the context of climate change alone (Smit and Wandel, 2006). With this in mind, adaptive capacity to climate change can only be analysed usefully within the context of wider development processes and interventions.

Linking adaptation and development

Adaptation in developing countries has attracted a great deal of attention in recent years. This is due, in part, to our increasing understanding of humankind’s influence on the climate system and the recognition that actions may be needed to help communities deal with the consequences. Addressing adaptation issues is a central part of the international climate change negotiations (UNFCCC, 2007).

The impacts of climate change are widespread, but its consequences will fall disproportionately on developing countries, and typically will hit the poorest communities within them the hardest (Smith et al., 2003). Generally, these communities also face a host of wider pressures, some of which may be influenced by the impacts of climate change – e.g. the threat of displacement in conflict, increasing population pressure on land, unequal resource distribution and globalisation (O’Brien et al., 2004).

Interventions to facilitate adaptation vary considerably in breadth, scope and appearance. Conceptually it is useful to distinguish between two distinct approaches (McGray et al., 2007). At one end of the spectrum, actions respond to impacts

associated directly with climate change, such as reducing the size of lakes prone to Glacial Lakes Outburst Floods (GLOFs) or erecting coastal embankments in areas threatened by rising sea levels. These impact-centric options tend to approach adaptation as distinct from, and additional to, ‘conventional’ development – though the concept of additionality in relation to adaptation has proven both technically and conceptually difficult to demonstrate, and has been widely criticised (Brown and Kaur, 2009).

At the other end of the spectrum, adaptation interventions can be approached as an integral part of ‘good development’. The premise here is that addressing the underlying drivers of poverty and vulnerability will help people and communities to respond to changing shocks and trends more generally, including climate change (Riché et al., 2009; Bapna and McGray, 2008).

Although LAC’s roots are in this second approach, in frameworks that look at underlying drivers of poverty and vulnerability, it is merely a framework for looking at change, not a theory of change. It can therefore be used as a lens to look at the impact of any intervention on a system’s capacity to adapt, no matter where such an intervention falls along the ‘spectrum’.

Characterising adaptive capacity

In order to understand how adaptive capacity can be influenced at the local level, it is important to characterise it. As discussed above, direct assessments of adaptive capacity are not feasible, and so it becomes necessary to identify the characteristics or features that influence it. Unfortunately, understandings of adaptive capacity are still very much in their infancy (Vincent, 2007), and there is no agreement about its characteristics and determinants at national, community or household level.

The Intergovernmental Panel on Climate Change (IPCC) identifies economic wealth, technology, information and skills, infrastructure, institutions and equity as the principal determinants of adaptive capacity (IPCC, 2001), though no distinction is made between determinants at national and local level. Recent assessments argue that social factors, in particular power relations – e.g. ‘social capital’, governance structures and the role and functions of institutions – have been underplayed in earlier studies (IPCC, 2007).

Much of the focus in assessments of adaptive capacity has been at the national level, with a heavy emphasis on assets and capitals (for examples of assessments of adaptive capacity at various levels see Yohe and Tol, 2002; Vincent, 2007; Kelly and

Adger, 2000; Haddad, 2005; Brooks et al., 2005; Brooks and Adger, 2004; Adger et al., 2004, 2003). A notable exception is the National Adaptive Capacity Framework, which focuses purely on a ‘function-based approach’ (WRI, 2009).

Asset-based frameworks of this sort typically rely on aggregate proxy data, and are often designed for comparison across countries (ibid.). As such, national-level indicators generally fail to capture many of the processes and contextual factors that influence adaptive capacity, and are not, therefore, an effective reflection of adaptive capacity at the level, where most adaptation actions take place (Eriksen and Kelly, 2007). Many frameworks have strong links to the Sustainable Livelihoods framework (SL), and have adopted the SL’s five ‘capitals’ (human, economic, social, physical and natural) as direct indicators of adaptive capacity at the community and household levels (see Osman Elsha et al., 2005; CARE, 2009; Deressa, 2008; Vincent, 2007). This has proven to be a useful starting point.

However, although the SL framework assists in establishing the resources available to assist adaptation, and has room to include intangible ‘assets’ and power relations (e.g. knowledge could fall under human capital, local institutions under social capital), it is not easy in practice to use the SL framework either to analyse the dynamic processes central to adaptive capacity, or to take into consideration power relations that may determine adaptive capacity at the local level.

Intangible factors, such as flexibility, innovation and redundancy, which are hard to capture in the SL framework, are integral aspects of a community’s ability to deal with internal and external shocks. For example, redundancy, and the extent to which components of a system can be substituted and interchanged to deal with failure or irrelevance, is an important precondition for adjusting and adapting to evolving circumstances (Ospina and Heeks, 2010). The SL framework has been criticised for not incorporating these features. LAC tries to make these more central,¹ without underplaying the importance of asset-based elements.

The Local Adaptive Capacity (LAC) framework

Based on the findings of ACCRA’s consultative process, the framework identifies five *distinct yet inter-related* characteristics that are conducive to adaptive capacity. These are: the asset base, institutions and entitlements, knowledge and information, innovation, and flexible forward-looking decision-making (see Figure 1 and Table 1 overleaf). These parameters

Figure 1: The relationships between characteristics of adaptive capacity at the local level

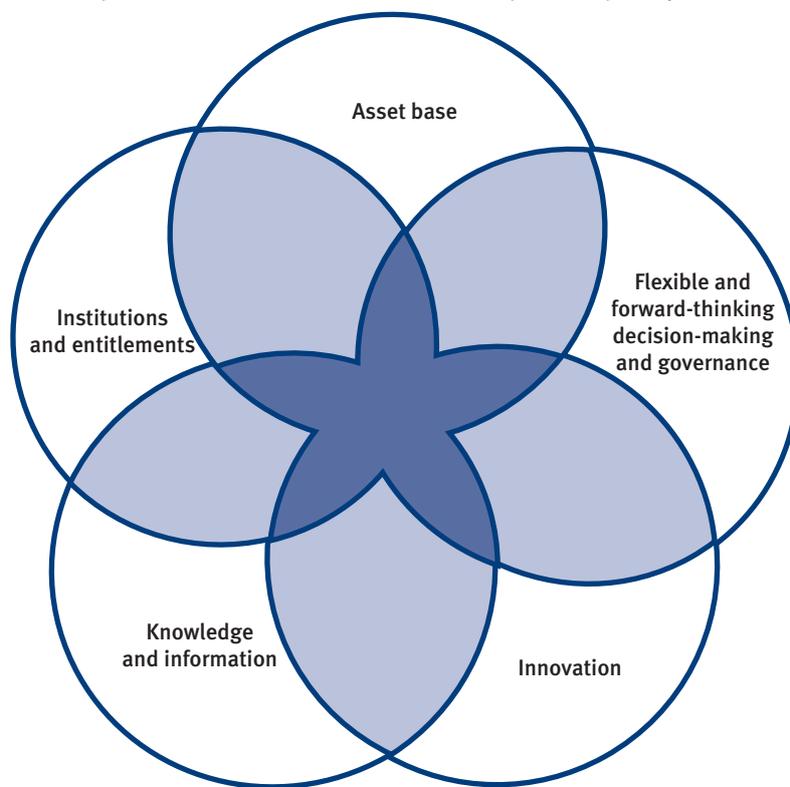


Table 1: LAC’s five characteristics and their features

Adaptive capacity at the local level	
Characteristic	Features that reflect a high adaptive capacity
Asset base	Availability of key assets that allow the system to respond to evolving circumstances
Institutions and entitlements	Existence of an appropriate and evolving institutional environment that allows fair access and entitlement to key assets and capitals
Knowledge and information	The system has the ability to collect, analyse and disseminate knowledge and information in support of adaptation activities
Innovation	The system creates an enabling environment to foster innovation, experimentation and the ability to explore niche solutions in order to take advantage of new opportunities
Flexible forward-looking decision-making and governance	The system is able to anticipate, incorporate and respond to changes with regards to its governance structures and future planning

influence and determine the degree to which a community is resilient and responsive to changes in the external environment. Figure 1 shows that the processes that shape these characteristics are very much *interdependent*: flexible forward-looking decision-making often requires accurate and applicable knowledge, information and expertise; successful innovation may derive from effective and supportive institutions.

The framework does not describe what an adaptive system looks like: it is a framework for looking at (and for) features that tend to support adaptive capacity. The ‘characteristics’ may be present in different

societies in many different forms. For example, adaptive capacity may be heightened where a community or household encourages innovation – the general characteristic – to take advantage of new opportunities presented. The specific features of any particular system that will encourage or discourage innovation may vary enormously. Including ‘innovation’ as a characteristic means that anyone using LAC will be prompted to think about innovation (see below) when analysing any aspect of the community/system, e.g. the impact of any development intervention. It does not mean that LAC assumes that innovation is always a prerequisite to increased adaptive capacity.

The asset base

The ability of a community to cope with and respond to change depends heavily on access to, and control over, key assets (Daze et al., 2009). Typically, it is the poorest that are most vulnerable to the impacts of climate change and wider developmental pressures, in large part because of their lack of, or restricted access to, key assets and capitals. Poverty has many dimensions, not merely income. Assets include both tangible capitals (natural, physical and financial) as well as intangible ones (human and social) (Prowse and Scott, 2008).

The relationship between assets and adaptive capacity is complex. Lack of availability and access to appropriate resources may significantly limit the ability of a system to cope with the effects of climate change and wider development pressures. Equally, an effective asset base depends on the extent to which components within the system are substitutable in the case of disruption or degradation of one component. As a result, asset diversity, and the ability to access assets that are in some sense surplus and interchangeable, may each be as important as simple ‘asset abundance’ (Ospina and Heeks, 2010).

Institutions and entitlements

Institutions are the ‘rules’ that govern belief systems, behaviour and organisational structure (Ostrom, 2005). Communities with well-developed social institutions are typically better able to respond to a changing environment than those with less effective institutional arrangements. Defining a ‘well-developed’ institution is, however, problematic and subjective. Access to and control of assets is mediated through institutions and entitlements, or claims. At the community level these are generally ‘informal’ local-level institutions or rules, and may include: land tenure rules, such as claims to common property resources; the ways in which farmers share knowledge; family, clan and church networks through which assets are shared; and ‘rules’ (unwritten) governing the rights of women.

Given that entitlements to ‘elements of adaptive capacity are socially differentiated along the lines of age, ethnicity, class, religion and gender’ (Adger et al., 2007: 730), it is often thought that institutions that ensure equitable opportunities to access resources are likely to promote adaptive capacity within a community.²

Institutions cannot, however, be measured solely according to asset distribution. Dimensions such as participation in decision-making; how institutions empower or disempower people; and the extent to which individuals, groups and communities have the right to be heard may prove key in determining both the degree to which a community is able to adapt, and the direction in which it does so (e.g. in response to whose interests?).

The institutional rules and behavioural norms that govern how *individuals* react in the face of shock and changing trends will also play a large role in adaptive capacity (Dulal et al., 2010). Social barriers to adaptation and the norms, rules and behaviour are all shaped by informal institutions, and can in many instances influence how individuals choose to cope and adapt to climate variability and change (see Jones, 2010). Another important component of the institutional environment is the capacity of institutions themselves to be flexible, and in some cases evolve, to allow communities to adapt.

Knowledge and information

Communities are often more likely to cope with change if they have appropriate knowledge about potential future threats, as well as an understanding of how to adapt to them. With this in mind, successful adaptation will require: understanding of likely future change and its complexity, knowledge about adaptation options, the ability to assess options, and the capacity to implement suitable interventions (Frankhauser and Tol, 1997). Knowledge can also play a role in ensuring local empowerment and raising awareness of the needs of particular groups within a community (Ospina and Heeks, 2010). Therefore, the way in which a system generates, collects, analyses and disseminates knowledge is an important determinant of adaptive capacity – with obvious links with the institutional context and the governance of knowledge.

Local generation and exchange of information is again often classed as ‘informal’, and contrasts with more ‘formal’ information provided by external and/or state actors. Communities need systems that can both optimise ‘informal’ knowledge generation and sharing, and maximise their uptake and use of external, ‘formal’ knowledge sources. In many contexts, adaptation will require effective services from outside the community itself to support the use of information. These services include quality education, the generation of information and expertise on climate or agriculture and much more effective communication of that information than has often been the case (Nagy, 2003).

Adaptation to any hazard, including climate change, does not depend on information only about the hazard itself. A community’s ability to know where to find and use new crop species or to apply for financing to fund investment in agricultural change are as important as knowing the weather forecast, and how the climate is expected to change in the future. Similarly, an important aspect is general awareness-raising and capacity-building of stakeholders to inform adaptation decisions (McGray, 2009). Relevant informa-

tion needs to reach key stakeholders to ensure that actions are effective in the long term, and prevent maladaptive practices (i.e. actions or processes that may deliver short-term gains but ultimately increase vulnerability in the longer term).

Innovation

A key characteristic of adaptive capacity relates to the system's ability to foster innovation and support new practices (Smith et al., 2003). As social and environmental changes continue, communities will need to alter existing practices, resources and behaviours, or in some cases adopt new ones. Experimentation, innovation and adoption as part of the learning process are essential in ensuring the system's ability to cope with and respond to changing circumstances. Moreover, innovation is crucial to enable a system to remain dynamic and functioning – though at the local level the willingness and capacity to foster innovation (and to accept failure) vary greatly.

It is important to recognise that this is not only about 'high-tech' and large-scale innovation, but also micro-level initiatives, as many of the actions taken to adapt to changing shocks and trends will be done spontaneously or autonomously at the local level (Wongtschowski et al., 2009). Such local innovations are often not recognised in the face of more technological or infrastructural innovations – though care should be taken not to 'over romanticise' traditional local practices.

Innovation is closely linked to *knowledge and communication*, as individuals analyse how best to take advantage of the opportunities presented by a changing environment (Wongtschowski et al., 2009), and to the asset base – which in part determines people's economic ability to take risks and to find the investment to innovate.

Flexible forward-looking decision-making and governance

A system's capacity to anticipate change and incorporate relevant initiatives into future planning and governance is an important aspect of adaptive capacity. Informed decision-making, transparency and prioritisation are key elements of adaptive governance. Decision-making and governance that is flexible, collaborative and learning-based may be responsive, adaptive and better able to cope with evolving circumstances. This recognises the importance of dynamic organisations, and the institutions, entitlements and assets they control in response to shock and changing trends (Smith et al., 2003). Moreover, decision-making systems can gain from being flexible enough to include new information and knowledge regarding changing environmental, social and political conditions.

Supporting the capacities of formal organisations to deal with a range of shocks and trends, and to coordinate response options, may help to ensure that communities deal better with the impacts of climate change and wider development pressures (Tompkins and Adger, 2004). An important part of this is ensuring that such organisations learn and are forward-looking in nature, anticipate future weaknesses and vulnerabilities and create opportunities for appropriate adaptive actions. Taking a longer-term approach within governance and decision-making is crucial in order to prevent maladaptive interventions (Ayers and Huq, 2009).

Any analysis of governance must look both at the 'technical' capacity of institutions and the power relations behind decision-making. The decisions that are made are usually less about the 'technical' features of decision-making forums and far more about whose voice is heard, and whose interests count. Various power imbalances exist in all societies – e.g. between rich and poor, between men and women and between old and young. How these imbalances are reflected in any specific society will influence the capacity of individuals to adapt to changing shocks and trends (Jones, 2010). LAC does not itself provide a tool for analysing power, accountability or responsiveness of governance structures, but the framework makes space for such analysis, using any methodology, to be included in an overall analysis of adaptive capacity.

Taking the framework forward

The five characteristics described under the LAC are a starting point to conceptualise adaptive capacity at the local level, and an entry point for discussion of national-level policies to increase community or household-level adaptive capacity. Further research will be needed to explore their relationships and roles, as well as to better understand the interrelations across each of the five characteristics.

The framework has the potential to be applied in a number of contexts and for a range of purposes. Its initial application in the ACCRA consortium is intended to shed light on how wider development interventions impact upon a community's adaptive capacity, both positively and negatively, and how existing approaches could be improved to optimise their contribution to communities' adaptive capacity. The findings will be used to inform and improve ACCRA members' policies and practice, to inform the wider development community's work on adaptive capacity and as a basis for influencing national governments around their development and adaptation policies.

There are a number of other opportunities to use LAC. At the programmatic level, it may be possible to

develop indicators to inform monitoring and evaluation, to guide the design of projects and to mainstream climate change adaptation considerations. It may also be used to inform or assess local or national level government and NGO policies and strategies, either those which seek deliberately to build local-level adaptive capacity, or to assess other policies against their ability to do this. Opening up the conceptual framework itself and sharing of the research based on the framework to a wide audience are the first steps on this road.

Written by ODI Research Officer Lindsey Jones (l.jones@odi.org.uk) and ODI Research Fellows Eva Ludi (e.ludi@odi.org.uk) and Simon Levine (s.levine@odi.org.uk). Essential comments and insights were provided by Josephine Lofthouse and Catherine Pettengell on behalf of the Africa Climate Change Resilience Alliance (ACCRA). Financial support for this discussion paper was provided through ACCRA by Oxfam GB. The ACCRA consultation version of the framework can be downloaded at <http://community.eldis.org/accra>.

To provide feedback on this publication, please visit: <http://bit.ly/fhXb7Z>

Endnotes and references

Endnotes:

- 1 While the LAC does not include redundancy as a separate characteristic, it does treat it as an emergent property and the analysis of all of the characteristics should include a 'redundancy lens'.
- 2 Developing empirical evidence for or against this is a challenge.

References:

- Adger, N., Agrawala, S. and Mirza, M.M.Q. (2007) 'Assessment of adaptation practices, options, constraints and capacity' in *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva: IPCC.
- Adger, N., Brooks, N. and Kelly, M. (2004) *New Indicators of Adaptive Capacity*. Norwich: Tyndall Center for Climate Change Research.
- Adger, N., Khan, S. and Brooks, N. (2003) *Measuring and enhancing adaptive capacity*. New York: UNDP (www.undp.org/cc/apf-outline.htm).
- Ayers, Jessica M. and Huq, Saleemul (2009) 'Supporting Adaptation to Climate Change: What Role for Official Development Assistance?', *Development Policy Review* 27 (6): 675-692.
- Bapna, M. and McGray, H. (2008) *Financing Adaptation: Opportunities for Innovation and Experimentation*. Washington, DC: World Resources Institute (www.brookings-tsinghua.cn/~media/Files/Programs/Global/brookings_blum_roundtable/2008_bapna_mcgray.pdf).
- Brooks, N. and Adger, N. (2004) *Assessing and Enhancing Adaptive Capacity: Technical Paper 7*. New York: UNDP (<http://ncsp.undp.org/docs/717.pdf>).
- Brooks, N. et al. (2005) 'The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation', *Global Environmental Change Part A* 15 (2): 151-163.
- Brown, J. and Kaur, N. (2009) 'Financing adaptation: matching form with function' ODI Background Note. London: Overseas Development Institute.
- CARE (2009) *The Climate Vulnerability and Capacity Analysis (CVCA) handbook*. London: CARE International (www.careclimatechange.org/cvca/CARE_CVCAHandbook.pdf).
- Deressa, T. (2008) *Measuring Ethiopian Farmers' Vulnerability to Climate Change Across Regional States*. IFPRI Discussion Paper 806. Washington, DC: International Food Policy Research Institute (www.ifpri.org/pubs/dp/IFPRIDP00806.pdf).
- Dulal, H. et al. (2010) *Capitalising on Assets: vulnerability and adaptation to climate change in Nepal*. Washington, DC: World Bank (www.wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2010/05/25/000333038_20100525035359/Rendered/PDF/546560NWP0121010Box34942301PUBLIC1.pdf).
- Eriksen, S. and Kelly, P. (2007) 'Developing Credible Vulnerability Indicators for Climate Adaptation Policy Assessment', *Mitigation and Adaptation Strategies for Global Change* 12 (4): 495-524.
- Frankhauser, S. and Tol, R.S.J. (1997) 'The social costs of climate change: the IPCC second assessment report and beyond', *Mitigation and Adaptation Strategies for Global Change* 1: 385-403.
- Gebre Michael, Y. and Mebratu, K. (2009) *Local innovation in climate-change adaptation by Ethiopian pastoralists*. Addis Ababa: Prolinnova (www.prolinnova.net/Downloadable_files/Ethiopia%20pastoral%20climate-change%20adaptation%20FINAL%20_2_.pdf).
- Haddad, B.M. (2005) 'Ranking the adaptive capacity of nations to climate change when socio-political goals are explicit', *Global Environmental Change Part A* 15 (2): 165-176.
- IPCC (2007) *Climate Change Impacts Adaptation and Vulnerability*. Geneva: IPCC.
- IPCC (2001) *Climate Change 2001: Impacts, Adaptation, and Vulnerability, Summary for Policymakers and Technical Summary of the Working Group II Report*. Geneva: IPCC.
- Jones, L. (2010) 'Overcoming Social Barriers to Adaptation'. ODI Background Note. London: ODI (www.odi.org.uk/resources/download/4945.pdf).
- Jones, L. et al. (2010) *Responding to a changing climate: Exploring how disaster risk reduction, social protection and livelihoods approaches promote features of adaptive capacity*. ODI Working Paper 319. London: ODI (www.odi.org.uk/resources/download/4790.pdf).
- Kelly, P.M. and Adger, W.N. (2000) 'Theory and Practice in Assessing Vulnerability to Climate Change and Facilitating Adaptation', *Climatic Change* 47 (4): 325-352.
- Kuriakose, A., Livia, B. and Bachofen, C. (2009) *Assessing vulnerability and adaptive capacity to climate risks: Methods for investigation at local and national levels*. Washington, DC: World Bank.
- Luers, A.L. et al. (2003) 'A method for quantifying vulnerability, applied to the agricultural system of the Yaqui Valley, Mexico', *Global Environmental Change* 13 (4): 255-267.
- McGray, H., Hammil, A. and Bradley, R. (2007) *Weathering the storm: Options for Framing Adaptation and Development*. Washington, DC: World Resources Institute.
- Nagy, G. et al. (2006) *Adaptive Capacity for Responding to Climate Variability and Change in Estuarine Fisheries of the Rio de la Plata*. Washington, DC: Assessments of Impacts and Adaptations to Climate Change (AIACC) (www.aiaccproject.org/working_papers/Working%20Papers/AIACC_WP36_Nagy%202.pdf).
- O'Brien, K. et al. (2004) 'Mapping vulnerability to multiple stressors: climate change and globalization in India', *Global Environmental Change Part A* 14 (4): 303-313.
- Osman Elsha, B. et al. (2005) *Sustainable livelihood approach for assessing community resilience to climate change: case*

- studies from Sudan*. Washington, DC: Assessments of Impacts and Adaptations to Climate Change (AIACC) (www.aiaccproject.org/working_papers/Working%20Papers/AIACC_WP_N0017.pdf).
- Ospina, A. and Heeks, R. (2010) *Linking ICTs and Climate Change Adaptation*. Manchester: University of Manchester.
- Ostrom, E. (2005) *Understanding Institutional Diversity*. Princeton, NJ: Princeton University Press.
- Pettengell, C. (2010) *Climate Change Adaptation: Enabling people living in poverty to adapt*. Oxford: Oxfam GB (www.oxfam.org.uk/resources/policy/climate_change/downloads/rr_climate_change_adaptation_full_290410.pdf).
- Prowse, M. and Scott, L. (2008) 'Assets and Adaptation: An Emerging Debate', *IDS Bulletin* (4): 42-52.
- Riché, B. et al. (2009) *Climate-related vulnerability and adaptive capacity in Ethiopia's Borana and Somali communities*. Manitoba: International Institute for Sustainable Development (www.iisd.org/pdf/2010/climate_ethiopia_communities.pdf).
- Smit, B. and Wandel, J. (2006) 'Adaptation, adaptive capacity and vulnerability', *Global Environmental Change* 16 (3): 282-292.
- Smith, J.B., Klein, R.J.T. and Huq, S. (2003) *Climate change, adaptive capacity and development*. London: Imperial College Press.
- Tompkins, E. and Adger, N. (2004) 'Does Adaptive Management of Natural Resources Enhance Resilience to Climate Change?', *Ecology and Society* 9 (2): 10.
- UNFCCC (2007) *Impacts, Vulnerabilities and Adaptation in Developing Countries*. New York: United Nations Framework Convention on Climate Change (<http://unfccc.int/resource/docs/publications/impacts.pdf>).
- Vincent, K. (2007) 'Uncertainty in adaptive capacity and the importance of scale', *Global Environmental Change* 17 (1): 12-24.
- Wongtschowski, M., Verburg, M. and Waters-Bayer, A. (2009) *Strengthening local adaptive capacities: the role of local innovation in supporting climate-change adaptation*. Addis Ababa: Prolinnova (www.prolinnova.net/Downloadable_files/073237%20Prolinnova%20working%20paper%200n%20Climate%20Change%20100209.pdf).
- WRI (2009) 'The National Adaptive Capacity Framework: Pilot Draft'. Washington, DC: World Resources Institute.
- Yohe, G. and Tol, R.S.J. (2002) 'Indicators for social and economic coping capacity – moving toward a working definition of adaptive capacity', *Global Environmental Change* 12 (1): 25-40.