

TOWARDS A HOLISTIC CONCEPTUALISATION OF ADAPTIVE CAPACITY AT THE LOCAL LEVEL: INSIGHTS FROM THE LOCAL ADAPTIVE CAPACITY FRAMEWORK (LAC)*

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1. Introduction

The concept of adaptive capacity is decidedly complex, and has to recognise the dynamic social, economic, technological and physical context that adaptation takes place within. The capacity to adapt to climate change at the community level will depend on a wide range of intangible variables, such as: *flexible decision-making and governance; access and entitlement to key resources; and an enabling institutional environment*. This complexity provides numerous challenges for our understanding of adaptive capacity at the local level, and how to go about conceptualise it. Reflected in this, many analytical frameworks for assessing adaptive capacity have largely focused on larger scales, such as at the national level, with little applicability for representing capacity at local and community levels where the majority of adaptation action will inevitably occur.

In order to allow effective evaluation, it is first important to identify common characteristics that help to support adaptive capacity at the local level. The Local Adaptive Capacity framework (LAC), developed under the Africa Climate Change Alliance project (ACCRA)¹, is one such initiative that attempts to move towards a better understanding of its core features through isolating five '*characteristics of adaptive capacity*'. Demonstrated through findings from field research across three African countries (Ethiopia, Mozambique and Uganda), this paper argues that frameworks for understanding and supporting adaptive capacity at the local level need to move away from focusing only on what communities have that enable them to adapt- *such as its various economic, social, human, natural and physical capitals*- to a greater acknowledgement of

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¹ 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/>



what a community does that enables it to adapt- *such as fostering innovation; promoting forward-looking flexible governance; and re-defining maladaptive norms, behaviours and institutions.*

By departing from traditional asset-based frameworks for conceptualising local adaptive capacity, the study highlights the important role that various intangible and dynamic processes, such as flexibility, innovation, and entitlements play in supporting capacity at the community level. Lastly, we explore how the LAC can be used to assess the important role that interventions not necessarily associated with climate change can play in helping a community's capacity to adaptive to climate variability and change. In doing so the paper makes a number of recommendations for researchers, policy makers and development practitioners alike, in helping to move towards a framework for understanding of adaptive capacity at the local level with aim the ultimate aim of supporting interventions that help to enhance it.

2. *How has adaptive capacity been conceptualised thus far?*

In the context of climate change, 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). The ability to directly measure and quantify an individual or community's capacity to adapt to climate variability and change is not something that can be done empirically. This is further complicated by the fact that our understanding of adaptive capacity, and the process that govern it are not fully understood (Vincent 2007). Indeed, no universal agreement over its features and determinants at nation, community or household level exist. That being said, in order to be able to analyse adaptive capacity, it is important to first identify common characteristics that can help to enhance it at the local level.

Efforts to assess adaptive capacity are in their relative infancy, though there have been a number of recent attempts to both conceptualise and evaluate adaptive capacity at various levels (Vincent 2007). Given the lack of a holistic framework for evaluating adaptive capacity at the local level, as well as the dynamic and complex institutional environment within which adaption actions are carried out, current understandings of adaptive capacity remain simplistic. A large proportion of the assessments that have been carried out have been based their analytical frameworks on assets and capitals as direct indicators of adaptive capacity (Brooks et al. 2005; WRI 2009). At the national level these have largely sought to allow comparison between countries, and tend to rely on aggregate proxy data such as indices of GDP, Gini coefficients, and access to basic resources. At the local level, a number of studies have drawn strong parallels between adaptive capacity and the Sustainable Livelihoods Framework (SL), often using its five assets (natural, human, financial, social and physical capitals) as a basis for characterising adaptive capacity.

3. *Moving away from asset-based frameworks*

While existing asset-based approaches are helpful in identifying the resources that are available to a system- *be it at the individual, community or national levels-* in coping with and adapting to a changing external environment, they do not give sufficient recognition to the processes and functions that are so imperative to supporting adaptive capacity at the local level. These processes are far harder to measure, and are often intangible in nature: such as the ability to ensure flexible and inclusive governance, or the capacity to prioritise and ensure forward looking decision making processes. Yet, they play an integral part in determining the ability of a

community to adapt to shock and stress, such as those experienced through climate variability and change.

As alluded to above, conceptual characterisations and assessments of adaptive capacity at the local level have typically been synonymous with the SL framework's five capitals (Daze et al. 2009). Indeed, a number of studies have adopted these capitals as direct indicators for measuring adaptive capacity at community and household levels (Deressa 2008; Osman Elsha et al. 2005; Vincent 2007). The various links between sustainable livelihoods, availability of assets and capitals, and adaptive capacity are manifold and provide a useful starting point in helping to understand the drivers behind adaptive capacity. However, given that so much of the ability to deal with climate variability and change will depend on these intangible processes, relationships and functions, solely looking at the community or individual's asset base is unlikely to give a complete picture of a system's adaptive capacity.

One attempt to move away from an asset-based framework is WRI's National Adaptive Capacity framework (NAC), which focuses solely on the important roles that assessment, prioritisation, coordination, information management, and climate risk reduction each play in supporting adaptive capacity at the national level (WRI 2009). Though a useful step forward in helping to recognise the role of functions in supporting adaptive capacity, these five features do not speak directly to the local context, nor do they acknowledge the important role that capitals do inevitably play. With this in mind we argue that so as to move towards a more holistic conceptualisation of adaptive capacity at the local level, an effective framework will have to give ample recognition to the important, and overlapping, role of both assets as well as functions. In light of this, the ACCRA programme seeks to understanding the complex environment within which a community may seek to respond and adapt to an increasingly variable and changing climate (see Jones et al. 2010).

4. What are the characteristics of adaptation capacity: insights from the LAC framework?

Central to ACCRA programme is the development of the Local Adaptive Capacity framework (LAC) through which it highlights five *distinct yet interrelated* characteristics of adaptation capacity at the local level. Each of which is considered to be conducive to enhancing local capacity. The makeup of these characteristics is identified through extensive local and national consultation with various stakeholders, as well as being trialled through pilot studies across each of the three country sites. Through having conducted the stakeholder engagement process, the study identifies the following as principle characteristics of adaptive capacity: *the asset base; institutions and entitlement; knowledge and information; innovation; and flexible forward looking decision-making* (see Figure 1 and accompanying Table 1).

These characteristics influence and determine the degree to which a community is resilient and responsive to changes in the external environment. As shown in Figure 1, the processes that shape these characteristics are very much *interdependent*: for example, flexible forward-looking decision-making often requires accurate and applicable knowledge, information and expertise; successful innovation may derive from effective and supportive institutions. Yet they each serve a very important and *distinct* role in helping to promote the ability of a community in adapting to shock and stress. Though the degrees to which each are conducive to supporting adaptive capacity will inevitable depend on the location and the type of threat, it is thought that each of the five characteristics have a certain degree of commonality with regards to community response to climate variability and change.

Figure 1: Conceptual diagram showing the relationships between characteristics of adaptive capacity at the local level

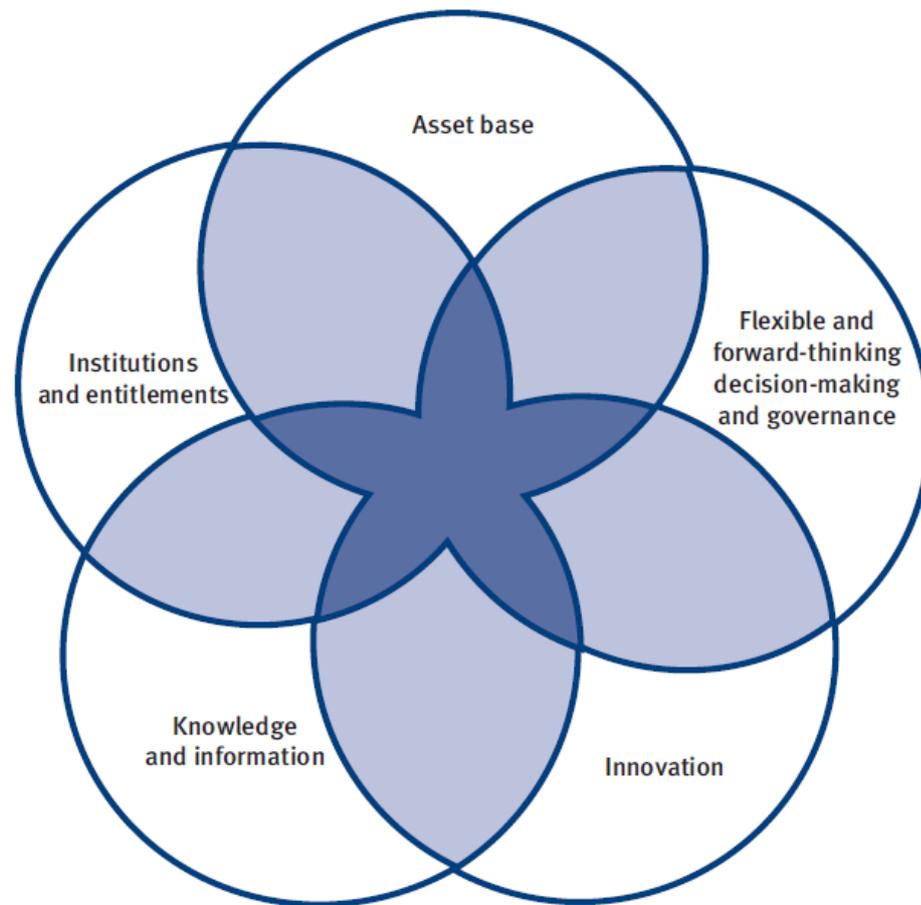


Table 1: LAC's five characteristics and summary of features

CHARACTERISTIC	FEATURES THAT REFLECT A HIGH ADAPTIVE CAPACITY
<i>Asset base</i>	Availability of key assets that allow the system to respond to evolving circumstances
<i>Institutions and entitlements</i>	Existence of an appropriate and evolving institutional environment that allows fair access and entitlement to key assets and capitals
<i>Knowledge and information</i>	The system has the ability to collect, analyse and disseminate knowledge and information in support of adaption activities
<i>Innovation</i>	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
<i>Flexible forward-looking decision-making and governance</i>	The system is able to anticipate, incorporate and respond to changes with regards to its governance structures and future planning

The framework does not describe what an adaptive system looks like: it is a framework for looking at 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. Below we describe each of the five identified characteristics in greater depth.

4.1 *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 & 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 & Heeks 2010).

4.2 *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, p.730), it is often thought that institutions that ensure equitable opportunities to access resources are likely to promote adaptive capacity within a community. 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.

4.3 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 & 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 & 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 et al. 2006) .

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 information 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).

4.4 Innovation

A key characteristic of adaptive capacity relates to the system’s ability to foster innovation and support new practices (Smith, Klein, 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.

4.5 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 & 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 & 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.

4.6 Applying the LAC framework

The five characteristics described under the LAC are a starting point to conceptualising 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.

4.7 Early lessons from the field

Though the full findings of the field research are yet to be received, preliminary analysis from the study sites suggests that the framework is helpful in providing a holistic conceptualisation of adaptive capacity. It is clear that in practical terms, assessing assets and capitals is a much easiest task. However, a thorough analysis of the wider governance and institutional environment is essential in determining local ability to respond to shock and stress. Moreover, the findings point to the implicit role of broader issues of political economy in dictating adaptive capacity. Many of these are largely entrenched into society and go beyond the scope of national NGO programme.

As part of the wider commentary on the SL framework and assessment of assets, the field research suggests that, while we are aware that different capitals, and their combinations, are important for supporting adaptive capacity, many current frameworks assume them to be of equal relevance. This appears to be unhelpful, as in practice certain assets and capitals will be more importance than others for supporting capacity. Further research may be needed to explore this in greater depth and isolate particular capitals most relevant to specific threats. Another early finding is that the assumption that equitable division of community resources is essential for collective adaptive capacity is potentially misleading. Examples from the Ethiopian study sites suggest that where there are very few resources available, such as land, it could be argued that supporting productive farmers to successfully exploit limited available resources may contribute more positively to collective adaptive capacity of the area and/or its local economy.

The research suggests that in practice, different characteristics tend to be addressed in isolation by specific interventions, such as a disaster risk reduction or social protection programme. This observation points to a greater need for coordination and the integrated implementation of activities to support adaptive capacity at the community level. Though useful starting points for analysis and discussion, it must be acknowledged that such findings are in their relative infancy and will look to be validated as the ACCRA project progresses.

5. Recognising the role of wider development interventions

One useful merit of the LAC framework is that it paves the way for assessing how wider social interactions affect local capacity to adapt as well as the role that wider development interventions may play in supporting it. This is important as the impacts of a changing climate will be felt not only in direct physical terms- *such as heavier rain fall events or longer dry spells*- but also in various indirect forms- *such as rising food prices or escalating local conflict over limited natural resources*. Moreover, individuals will typically have to deal with a whole host of other development pressures- *such as increasing population pressure on land, unequal resource distribution and globalisation* (O'Brien & Leichenko 2000). The ability to respond to each of these threats is determined, in part, by both internal and external factors, and will be played out through various institutions and social characteristics (Jones 2010), with impacts typically falling disproportionately on the poorest and marginalised- whom lack access and entitlement to key resources and whose interests are seldom recognised ahead of local

While some adaptation interventions are concerned solely with addressing the impacts of climate shocks and stress, at the opposite end of the spectrum, a great many adaptation interventions can be associated with tackling the underlying drivers of vulnerability (McGray et al. 2007). It is here where efforts to address adaptation are blurred, and overlap strongly with development. Indeed, it can be argued that these vulnerability-centred approaches to adaptation can be conceived of as synonymous with development activities and ‘good development’ (Ayers & Huq 2009). Thought of in this way, it is possible to see how wider development interventions- *such as social protection, disaster risk reduction and livelihoods programmes*-, which may not have been designed specifically with climate change in mind, can have a significant impact in helping to respond to the impacts of a changing climate.

In doing so, the LAC framework provides a useful tool in analysing how wider development interventions can help support communities in adapting to climate variability and change, and in particular which characteristics of adaptive capacity they are helpful in contributing towards. For example, interventions that help to support and strengthen local institutions or assist in securing entitlement to key resources for marginalised groups will likely have various positive implications for supporting the recipient’s ability to deal with shock and stress- *both directly and indirectly*.

6. *Conclusions: moving towards a holistic understanding of adaptive capacity*

In developing its conceptual framework, the LAC seeks to facilitate an understanding of community-level adaptive capacity that moves beyond purely analysing assets and capitals, towards a more thorough assessment that includes the important role of process and functions. In doing so, the framework acts as a tool to consider how interventions, not typically associated with tackling climate variability and change, may contribute to supporting adaptive capacity. Knowledge of how such interventions complement and support each other in enhancing resilience to climate shock and stress is of great importance, particularly in helping to guide future programming and the allocation of financial and technical resources.

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. Though only the start of an extensive study, the framework’s development and preliminary site findings provide a number of useful starting points. As results from the field research come to light, the programme hopes to validate the framework’s conceptual underpinnings, and provide useful insights into what aspects of the five characteristics are most important to supporting adaptive capacity. This is done with the ultimate aims of advancing our understanding of the complex and dynamic processes that shape adaptive capacity, seeking to support better programming and coordination amongst interventions in support of local communities that are most in need.

References

- Adger, N., Agrawala, S. & Mirza, M.M.Q., 2007. Assessment of adaptation practices, options, constraints and capacity. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Intergovernmental Panel on Climate Change.
- Ayers, J.M. & Huq, S., 2009. Supporting Adaptation to Climate Change: What Role for Official Development Assistance? *Development Policy Review*, (6), pp.675-692. Available at: [Accessed November 9, 2010].
- Brooks, N., 2003. *Vulnerability, risk and adaptation: A conceptual framework*, Norwich: Tyndall Center for Climate Change Research. Available at: http://www.tyndall.ac.uk/publications/working_papers/wp38.pdf.
- Brooks, N., Adger, N. & Kelly, M., 2005. The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. *Global Environmental Change Part A*, 15(2), pp.151-163. Available at: [Accessed March 23, 2009].
- Daze, A., Amborse, K. & Ehrhart, C., 2009. *Climate Vulnerability and Capacity Analysis*, Care International. Available at: http://www.careclimatechange.org/cvca/CARE_CVCAHandbook.pdf.
- Deressa, T., 2008. *Measuring Ethiopian Farmer's Vulnerability to Climate Change Across Regional States: IFPRI Discussion Paper 806*, International Food Policy Research Institute. Available at: <http://www.ifpri.org/pubs/dp/IFPRIDP00806.pdf>.
- Dulal, H. et al., 2010. *Capitalising on Assets: vulnerability and adaptation to climate change in Nepal*, Washington, D.C. The World Bank. Available at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2010/05/25/000333038_20100525035359/Rendered/PDF/546560NWP0121010Box349423B01PUBLIC1.pdf.
- Frankhauser, S. & 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, pp.385-403.
- Jones, L., 2010. *Overcoming Social Barriers to Adaptation*, London: Overseas Development Institute. Available at: <http://www.odi.org.uk/resources/download/4945.pdf>.
- Jones, L., Ludi, E. & Levine, S., 2010. *Towards a characterisation of adaptive capacity: a framework for analysing adaptive capacity at the local level*, Overseas Development Institute. Available at: <http://www.odi.org.uk/resources/download/5177.pdf>.
- McGray, H., 2009. *Bellagio Framework for Adaptation Assessment and Prioritization*, World Resources Institute. Available at: http://pdf.wri.org/working_papers/bellagio_framework_for_adaptation.pdf.
- McGray, H., Hammil, A. & Bradley, R., 2007. *Weathering the storm: Options for Framing Adaptation and Development*, 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, Assessments of Impacts and Adaptations to*

Climate Change (AIACC). Available at:
http://www.aiaccproject.org/working_papers/Working%20Papers/AIACC_WP36_Nagy%202.pdf.

O'Brien, K. & Leichenko, R., 2000. Double exposure: assessing the impacts of climate change within the context of economic globalization. *Global Environmental Change*, 10(3), pp.232, 221. Available at: [Accessed April 7, 2009].

Osman Elsha, B. et al., 2005. Sustainable livelihood approach for assessing community resilience to climate change: case studies from Sudan, *Assessments of Impacts and Adaptations to Climate Change (AIACC)*. Available at:
http://www.aiaccproject.org/working_papers/Working%20Papers/AIACC_WP_No017.pdf.

Ospina, A. & Heeks, R., 2010. *Linking ICTs and Climate Change Adaptation*, Manchester: University of Manchester.

Ostrom, E., 2005. *Understanding Institutional Diversity*, Princeton: Princeton University Press.

Prowse, M. & Scott, L., 2008. Assets and Adaptation: An Emerging Debate. *IDS Bulletin*, (4), pp.42-52.

Smith, J.B., Klein, R.J.T. & Huq, S., 2003. *Climate change, adaptive capacity and development*, Imperial College Press.

Tompkins, E. & Adger, N., 2004. Does Adaptive Management of Natural Resources Enhance Resilience to Climate Change? *Ecology and Society*, 9(2), p.10.

Vincent, K., 2007. Uncertainty in adaptive capacity and the importance of scale. *Global Environmental Change*, 17(1), pp.12-24. Available at: [Accessed March 24, 2009].

Wongtschowski, M., Verburg, M. & Waters-Bayer, A., 2009. Strengthening local adaptive capacities: the role of local innovation in supporting climate-change adaptation, *Prolinnova*. Available at:
http://www.prolinnova.net/Downloadable_files/073237%20Prolinnova%20working%20paper%20on%20Climate%20Change%20100209.pdf.

WRI, 2009. *The National Adaptive Capacity Framework: Pilot Draft*, Washington, D.C. World Resources Institute.