

Chapter 14. Adaptation Needs and Options**Coordinating Lead Authors**

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43 **Executive Summary**

44
45 **The most commonly used definitions of adaptation remain based on the IPCC AR3 definition** (“adjustment in
46 natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm
47 or exploits beneficial opportunities”), but with some important elaborations being proposed. The IPCC SREX
48 modified the definition and included an element of purposefulness in human adaptation actions (i.e. “in order to
49 moderate...”). Others have sought to place adaptation into a wider context of interacting non-climatic changes and to
50 include adaptation actions that may not succeed in moderating harm. Increasing focus on the costs of adaptation and
51 on evaluating adaptation practices has led to more attention to what constitutes successful adaptation. Some
52 definitions of success emphasize reducing risks to a predetermined level while other focus on achieving
53 predetermined levels of social and or economic well being. [14.2.1]

54

1 **Since AR4 the framing of adaptation has moved further from a focus on biophysical vulnerability to the**
2 **wider social and economic drivers of vulnerability.** [14.2.1.1] These include the gender, age, health, social status
3 and ethnicity of individuals and groups and the political system in place within a region and country. [14.2.1.1.2,
4 14.2.1.1.3]

5
6 **Adaptation activity is increasing and becoming more integrated within wider policy frameworks.** Integration
7 streamlines the planning and decision making process and embeds climate sensitive thinking in existing institutions
8 and organizations. Integration helps avoid mismatches with development planning, facilitates the blending of
9 multiple funding streams and reduces the possibility of maladaptive actions. There are many synergies between
10 adaptation and disaster risk reduction and step are being taken to achieve better integration. [14.2.2] However,
11 barriers remain arising from different terminologies, areas of focus and pre-existing institutional structures.
12 [14.2.2.3]

13
14 **Experience in adaptation practice is increasing rapidly,** which serves to clarify the most significant barriers and
15 opportunities for adaptation. Most governments, developed and developing, are seeking to integrate adaptation
16 planning and implementation within wider national and sectoral planning. More local and community based efforts
17 are still challenged by the need to scale up effective practices. [14.2.2.4] Access to finance and the means of access
18 remain impediments to greater action. [14.2.3.3, 14.3.1.4]

19
20 **Most of the assessments done so far have been restricted to impacts, vulnerability and adaptation planning.**
21 Very few assessments have yet been done on the processes of implementation and evaluation of actual adaptation
22 actions. [14.5]

23
24 **Evaluation of adaptation effectiveness is still in its infancy.** Experience in selecting metrics to identify adaptation
25 needs and to measure effectiveness is increasing. [14.6.3, 14.6.4] But the search for metrics for adaptation will
26 remain contentious with multiple alternatives competing for attention as institutions, communities and individuals
27 value needs and outcomes differently and many of those values cannot be captured in a comparable way by metrics.
28 [14.6.2]

30 31 **14.1. Introduction**

32
33 Adaptation entails preparing for the impacts of climate change. As such, it is relevant to national, regional, and local
34 governments as well as to the private and nonprofit sectors. Failure to adapt in a timely manner to anticipated
35 climate change will increase the likelihood of human suffering and economic losses and may undermine the
36 ecosystem and societal services upon which we all depend.

37
38 Adaptation has a long history, but one where practice is outpacing policy and, while adaptation related research is
39 growing, it has not yet been able to deliver strong frameworks and guidance. In this chapter, we review overarching
40 issues related to adaptation, with an emphasis on key considerations, actors, and processes that have been
41 understood about adaptation efforts. This chapter establishes a foundation for understanding adaptation, and, at the
42 same time, provides a basis for successive chapters in this section to explore adaptation in greater depth. In order to
43 frame these discussions, it is important to clarify what is meant by needs and options and to review how these
44 concepts fit with other terms and views advanced across the adaptation chapters. In this discussion, needs refers to
45 risks posed to valued attributes that exceed acceptable and desired levels. These needs typically should be identified
46 through assessment processes. Options are the array of strategies used to address the needs that have been identified.
47 There is a broad array of needs that emerge from assessments as well as a plethora of options that can be advanced.
48 Rather than delve into and chronicle specifics, which would result in a massive catalog, we review fundamental
49 aspects and cross-cutting issues shaping needs and map out the broad categories under which options are situated.

14.1.1. *Summary of Key Findings from AR4*

The Fourth Assessment Report (AR4) defined the basic terminology of adaptation and concluded that adaptation to climate change was already taking place, but on a limited basis. Societies have a long record of adapting to the impacts of weather and climate through a range of practices that include crop diversification, irrigation, water management, disaster risk management, and insurance, but climate change poses novel risks often outside the range of experience.

Deliberate adaptation measures in response to anticipated climate change were being implemented by a range of public and private actors, on a limited basis, in both developed and developing countries. These measures are undertaken through policies, investments in infrastructure and technologies, and behavioral change. These adaptation measures are seldom undertaken in response to climate change alone. Many actions that facilitate adaptation to climate change are undertaken to deal with current extreme events such as heatwaves and cyclones often embedded within broader sectoral initiatives such as water resource planning, coastal defence and disaster management planning.

AR4 concluded that there are individuals and groups within all societies that have insufficient capacity to adapt to climate change. The capacity to adapt is dynamic and influenced by economic and natural resources, social networks, entitlements, institutions and governance, human resources, and technology. But, high adaptive capacity does not necessarily translate into actions that reduce vulnerability.

New planning processes were being implemented to attempt to overcome these barriers at local, regional and national levels in both developing and developed countries. AR4 noted the establishment of the National Adaptation Programmes of Action (NAPAs) and that some developed countries had established national adaptation policy frameworks.

Other conclusions from the AR4 relating the implementation of adaptation policies and measures, barriers to adaptation and the economic costs of adaptation are summarized in Chapters 15, 16 and 17.

14.1.2. *Structure of the Chapter and its Relationship with Other Chapters*

As stated in the introductory section, this chapter serves as an entry to the following three chapters, which deal with the planning and implementation of adaptation (Chapter 15); the opportunities and constraints to adaptation (Chapter 16); and the economic costs and benefits of adaptation (Chapter 17). It revisits the core definitions and concepts of adaptation and maladaptation. It discusses the factors determining vulnerability to climate change in relation other stressors and societal trends and examines the need for adaptation across all sectors of society and in all parts of the world. It then outlines the options that exist to address adaptation needs. An ongoing theme throughout the chapter is the concept of mainstreaming or the integration of adaptation to climate change with other areas of government action and responsibility. This chapter also serves to set the basis of some important tools in implementing adaptation; namely approaches to assessing needs at national, subnational and sectoral levels, and the challenges of applying metrics to determine adaptation needs and the effectiveness of adaptation actions.

14.2. **Foundations of Adaptation**

14.2.1. *Understanding Adaptation*

Given historical and current levels of emissions stemming from human activities, it is expected that the climate will continue to change (IPCC, 2007a; Stott *et al.*, 2010). These changes are predicted to be accompanied by greater variability in temperatures, precipitation, and extreme weather events that, in turn, will impact a wide range of critical functions and areas, including food production, water availability and quality, coastal and marine systems, disease vectors, and housing and building stability (IPCC, 2007b; Füssel, 2009). Given that these changes will affect

1 the functions and well-being of natural systems, human societies, and the built environment, it is essential for
2 countries and subnational areas to be prepared by taking action to adapt (IPCC, 2007b).

3
4 Climate adaptation is defined as “adjustment in natural or human systems in response to actual or expected climatic
5 stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC, 2007b: 869). While this
6 definition is widely accepted¹, there is still a great deal of variability in views about the objectives of adaptation. As
7 a result, our understanding of what constitutes successful adaptation span from maintaining present levels of risk, to
8 reducing current risks, to minimizing the exposure of vulnerable populations (Doria *et al.*, 2009). Based on Delphi
9 methodology, Doria *et al.*, (2009) were able to identify shared views of adaptation. Their findings suggest that it is
10 generally regarded as any type of adjustment that reduces climate risks or vulnerability to climate impacts to levels
11 set by affected actors or decision makers and that promotes efforts to achieve economic, social, and environmental
12 sustainability (Doria, *et al.*, 2009).

13
14 [FOOTNOTE 1: In the SREX (IPCC 2012) the definition was altered to “In human systems, the process of
15 adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial
16 opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may
17 facilitate adjustment to expected climate.” This is essentially the same, but with the addition of purposefulness (“in
18 order to”) of adaptation in human versus natural systems in the SREX.]

19
20 In this chapter, adaptation needs are defined as risks and other circumstances requiring action to ensure safety of
21 populations and security of assets in response to climate impacts. Given this perspective, adaptation options are the
22 array of strategies and measures available and appropriate to a given context for addressing adaptation needs that
23 have been identified. Adaptation engages people, organizations, and governments at all levels in meeting goals
24 ranging from continuing current activities to assuring acceptable levels of risk and sustainable development. From
25 the perspective of those pursuing adaptation, the existence of adaptation options does not necessarily mean that these
26 options can be implemented when the need arises. As elaborated in Chapter 15, opportunities, or those sets of
27 circumstances that make successful adaptation possible or easier to achieve, may be missed. In addition, there often
28 are socio-economic or biophysical constraints that restrict the number of adaptation options make them more
29 difficult to implement as well as limits that make it impossible for an actor to achieve some adaptation objectives.
30 Some of these limits are mutable and can be overcome eventually, while others are absolute and cannot be changed.

31 32 33 *14.2.1.1. Perspectives on Vulnerabilities*

34
35 The approach to adaptation needs and options adopted in this chapter reflects the emphasis most definitions of
36 adaptation place on reducing vulnerability or the potential to be harmed. According to AR4 (IPCC, 2007a),
37 vulnerability is the degree to which a system is “susceptible to, and unable to cope with, adverse effects of climate
38 change.” The concept of vulnerability traditionally is viewed as being comprised of three elements: exposure,
39 sensitivity and adaptive capacity (IPCC, 2007a). In other words, the stress faced by a system or individual, the
40 extent to which the system will be affected, and the degree to which the system is able to cope with or respond to
41 these stresses (Cutter, 1996; Cutter *et al.*, 2003; O’Brien *et al.*, 2004; Adger, 2006). From an adaptation standpoint,
42 this concept is used to explicate contextual factors associated with exposure (Leichenko and O’Brien, 2008). For
43 instance, vulnerability at the national and sub-national levels is affected by geographic location, biophysical
44 conditions, institutional and governance arrangements, and resource availability, including access to technology and
45 economic stability. At the individual level it is shaped by personal characteristics such as gender and health as well
46 as by social status and networks (Ionescu *et al.*, 2009). At the same time, vulnerability is used to identify and
47 understand the ability of different systems and groups to cope with climate impacts (Leichenko and O’Brien, 2008).

48
49 Multiple sources of stress, some from climate impacts and some from other sources, combine to increase
50 vulnerability. For instance, existing coastal erosion, deforestation and habitat fragmentation become even more
51 serious problems when coupled with the projected impacts of climate change (Ayache *et al.* 2009; Werner and
52 Simmons, 2009; Sánchez-Arcilla *et al.*, 2008). Multiple stressors also increase the risks to human populations.
53 Numerous countries within Africa, for instance, face a critical convergence of deleterious multiple stressors,
54 including the spread of HIV/AIDS, poverty, scarcity of basic resources and services, and armed conflict. In

1 combination, these and other stressors are leading to greater vulnerability across the continent (Fields, 2005). As
2 these examples suggest, multiple stressors can be additive or cumulative, resulting in impacts that are greater than
3 any single stressor would produce.

6 *14.2.1.1.1. Biophysical perspectives*

7
8 Early views of climate impacts emphasized the magnitude of biophysical threats arising from climate change to
9 define vulnerability and the need for adaptive actions (Adger, 1999; Brooks, 2003; Brooks *et al.*, 2005). This view
10 continues to be widely used to understand climate impacts. For instance, Hanson *et al.* (2011) offer a global ranking
11 of the vulnerability of port cities using biophysical indicators. While this orientation persists, a variety of views of
12 vulnerability have emerged, many combining biophysical and social perspectives of vulnerability (Adger *et al.*,
13 2003; Füssel and Klein, 2006). This refinement has contributed to a more operational concept of vulnerability that
14 focuses on its underlying causes and on actions to reduce vulnerability without waiting for ongoing refinements in
15 estimates of the size and location of climate hazards.

18 *14.2.1.1.2. Social perspectives*

19
20 From a social perspective, vulnerability varies as a consequence of the capacity of groups and individuals to cope
21 with the impacts of climate change. Among the key factors associated with vulnerability are gender, age, health,
22 social status, ethnicity, and class (Adger *et al.*, 2009; Smit *et al.*, 2001). For instance, the elderly and infirmed may
23 not have the financial resources or social capital necessary to relocate or the physical capacity to evacuate when
24 natural disasters strike. Those who are socially isolated may have difficulty adjusting to the changes taking place
25 around them while those who do not speak the national language, such as immigrants and foreigners, may be unable
26 to learn about impending issues. Ethnic minorities have a long history of unequal treatment in many parts of the
27 world and these disparities often become acute in the aftermath of natural disasters.

28
29 Climate change is expected to have a significant impact on the poor as a consequence of their lack of financial
30 resources, poor quality of shelter, exposure to the elements, and limited provision of basic services, (Patz *et al.*,
31 2008; Moser and Satterthwaite, 2010; Huq *et al.*, 2007; Shikanga *et al.*, 2009; Kovats and Akhtar, 2008; Revi, 2008;
32 Tol *et al.*, 2004; Gething *et al.*, 2010; Rosenzweig *et al.*, 2010). There are numerous instances where the poor have
33 been able to adapt to changes. However, in addition to limited financial resources, the health and nutritional status of
34 poor populations often is compromised. As a result, along with the sick and elderly, they are at increased risk from
35 illness and death from climate-impacts such as increased pollution, higher indoor temperatures, exposure to toxins
36 and pathogens from floods, and the emergence of new disease vectors (Kasperson and Kasperson, 2001; Haines *et*
37 *al.*, 2006; Costello *et al.*, 2009; O'Neill and Ebi, 2009; Tonnang *et al.*, 2010; Costello *et al.*, 2011; Ebi, 2011; Harlan
38 and Ruddell, 2011; Huang *et al.*, 2011; McMichael and Lindgren, 2011; Semenza *et al.*, 2012). In a survey of
39 recovery from shocks in Pakistan, Heltberg and Lund (2009) found that when faced with health and economic
40 challenges, poor households often do not have sufficient coping mechanisms to rebuild their assets. This leaves them
41 more prone to destitution and associated problems of food insecurity and landlessness (Heltberg and Lund, 2009). A
42 further consideration is that many poor, as well as indigenous, populations maintain subsistence lifestyles. Climate-
43 induced changes in temperature, weather, and pollution will affect habitats and result in an inability to obtain or
44 grow food supplies thereby posing challenges to their food security (Huq *et al.*, 2007; Sivakumar and Hansen, 2007;
45 Ford *et al.*, 2008; Gero *et al.*, 2011).

48 *14.2.1.1.3. Political perspectives*

49
50 Political systems and politics are important in shaping and understanding national and sub-national vulnerability.
51 Different types of regimes rely on different types of policy instruments. For instance, drawing on case studies of
52 water systems in the Middle East and North Africa, Sower *et al.* (2011) maintain that these largely centralized
53 systems of planning, taxation, and revenue distribution render these governments more vulnerable since they are
54 limited in their ability to adapt to climate change. Further, while there are jurisdictional, institutional, economic, and

1 technical issues that come into play, there also are a number of ongoing political issues that shape the relationships
2 local governments have to managing climate risks (Corfee-Morlot *et al.* 2011). For instance, short-term election
3 cycles, when dealing with long-term issues can limit incentives to make investments. Similarly, the proximity that
4 authorities have to interest groups can sway their decisions toward other issues, while the drive to engage the public
5 in planning and other activities can orient priorities in ways that do not support adaptation. Collectively, these
6 situations have the potential to both foster as well as address vulnerabilities (Corfee-Morlot *et al.* 2011).

7
8 Rapid onset events, such as floods, and slow onset events including water shortages, famine, and desertification can
9 serve as triggers for human migration, both within a given country as well as across borders. Based on case studies
10 conducted in areas of Vietnam and Mozambique that are prone to rapid-onset flooding and in Egypt where they are
11 facing slow-onset hazards of desertification as well as the potential of sea level rise, Warner *et al.* (2010) found
12 patterns similar to those associated with conflict. Specifically, they suggest that economic and social factors are the
13 major drivers of migration at the present time, but environmental forces associated with natural hazards contributed
14 to the relocation process (Warner *et al.*, 2010). Further, stresses such as poverty, high population growth and
15 density, and low levels of economic development can exacerbate the situation even further since they are intertwined
16 with access to resources and the ability to cope with stressors associated with climate change (Gemenne, 2011;
17 Warner *et al.*, 2010).

18 19 20 *14.2.1.1.4. Economic perspectives*

21
22 In assessing vulnerability in relation to adaptation, economic and social elements are often combined in a
23 socioeconomic perspective. However, in some circumstances the emphasis is much more directly on the economic
24 component. This is particularly true in disaster risk assessment and in comparing the needs of different countries,
25 regions or sectors. Here the assessment typically uses the building blocks of probabilistic risk analysis to deliver for
26 a particular scenario a quantitative estimate of the magnitudes of the hazard, exposure, vulnerability, and losses
27 expressed in economic terms. Often the analysis is extended via randomized evaluations of the model to calculate
28 the probability that a certain level of loss will be exceeded leading to a “loss exceedance curve”, which then can be
29 used to calculate other useful planning variables such average annual loss or probable maximum loss (Ghesquiere
30 and Mahul, 2010; Anon 2010; IPCC, 2012).

31
32 Recently there have been efforts to estimate the economic costs of adaptation both at global (see Chpt 17) and
33 national level (Brander, 2010; Galindo and Samaniego, 2010; Tonnang *et al.*, 2010; Conway and Schipper, 2011).
34 One challenge has been to define and operationalize the concept of adaptation costs (Martens *et al.*, 2009; van
35 Ierland *et al.*, 2007). The IPCC defines adaptation costs as the costs of planning, preparing for, facilitating, and
36 implementing adaptation measures, including transaction costs (AR4 Glossary). But this is still difficult to
37 operationalize and does not include losses avoided. In a multi-country comparison, the World Bank (2010)
38 established a baseline development path for each country with no climate change using standard economic forecasts
39 and assuming that countries grow along reasonable development path. Then the calculations were repeated, sector
40 by sector, assuming an appropriate level of adaptation. But there are many options as to that level. One option is to
41 adapt completely, so that society is at least as well off as it was before climate change, but this may be prohibitively
42 expensive. At the other extreme, countries could choose to do nothing, experiencing the full impact and losses from
43 climate change. In the intermediate cases, countries invest in adaptation using the same criteria as for other
44 development projects—until the marginal benefits of the adaptation measure exceed the costs. This method still had
45 serious limitations. For example it was not able to deal with non-monetary losses such as those associated with
46 ecosystems services, or costs of “soft adaptation options” such as institutional reform and strengthening.

47
48 Another approach (Economics of Climate Adaptation Working Group, 2011) sought to estimate the potential climate
49 change losses over coming decades (20 years), how much could be averted, with what measures, what investments
50 would be needed, and where benefits outweigh losses. It provides a systematic presentation of the costs of
51 adaptation actions against the losses avoided, to assist decision makers to visualize the range of adaptation options
52 available.

14.2.1.2. Adaptive Capacity

All regions and all countries of the world are vulnerable to the impacts of climate change. Attending to these impacts requires that countries and sub-national bodies have sufficient capacity to adapt. Adaptive capacity refers to the ability to recover, adjust, or cope with the impacts of climate change (Smit and Pilifosova, 2001; Smit and Wandel, 2006; IPCC 2007a; Nelson *et al.*, 2007; Jernek and Olsson, 2008). This can take place through advance preparation or through response at the time an event takes place (Smit *et al.*, 2001). Adaptive capacity is not limited to the ability to maintain an existing state, but reflects flexibility to transition to one that is more desirable (Engle and Lemos, 2009). What constitutes adaptive capacity varies in light of specific challenges and contexts (Adger *et al.*, 2007), but it is closely tied to the availability of tangible resources, including money, political power, and access to information and technology (Yohe and Tol, 2001; Smit and Wandel, 2006). While tangible resources are important, those associated with strong governance measures, such as institutions, networks, and civil and political rights, also contribute to the adaptive capacity of nations, regions, cities, and communities (Engle, 2011; Adger, 2006; Eakin and Lemos, 2006; Brooks *et al.*, 2005).

Fostering adaptive capacity typically is associated with preparing for climate change in both national and sub-national contexts and in biophysical, social and political domains. Because of their limited resources, developing countries, small island developing states, and poor populations have limited adaptive capacity and therefore, are among the least able to cope with climate impacts (Adger *et al.*, 2003; Dow *et al.*, 2006). As a result, adaptive capacity is closely tied to the development path that is pursued by national and by sub-national bodies. Achieving widespread commitment in both developed and developing country contexts may require that adaptation is aligned with and integrated into ongoing economic and sustainable development efforts (Ayers and Dodman, 2010; Conway and Schipper, 2011; Eriksen and Brown, 2011; Tanner and Allouche, 2011).

14.2.2. Mainstreaming Adaptation

Adaptation complements and has the potential to achieve co-benefits with and produce new opportunities in many policy and planning arenas. As an alternative to pursuing isolated action, a mainstreaming approach focuses on linking adaptation to national and local goals and priorities. The rationale behind mainstreaming is that integrated interventions can have effects surpassing those of disaggregated, fragmented, or differentiated initiatives (Chuku, 2010). Mainstreaming emphasizes synergies between adaptation and ongoing activities of government ministries and departments as well as practical activities taking place at the community and household levels (Smit and Wandel, 2006; Agrawala, 2005; Willbanks and Kates, 2010).

By developing an integrated plan of action, mainstreaming enhances the ability to streamline decision-making processes and accommodate an adaptation agenda without reinventing institutions and organizations (Smit and Wandel, 2006). It also can promote long-term sustainability of adaptation activities (Warner *et al.*, 2010), and reduce future remedial costs (Agrawala and van Aalst, 2008), such as those that could emerge from maladaptation, poor decision-making tools, and mismatches in development trajectories.

While adaptation offers complementarities and co-benefits with a variety of policy and planning arenas, this section focuses on linkages to and mainstreaming with climate change mitigation, development planning, and disaster management and hazard risk reduction.

14.2.2.1. Integrating with Mitigation

For many years, mitigation and adaptation have been viewed as relatively separate issues (Martens *et al.*, 2009), with mitigation seen more as a more pressing issue for developed countries and adaptation a priority for developing nations (Ayers and Huq, 2009). However, there is growing recognition that both are integral aspects of managing climate change (Willbanks *et al.*, 2003; Dowlatabadi, 2007; Klein *et al.*, 2007; Swart and Raes, 2007; Venema and Rehman, 2007; Ayers and Huq, 2009; Larsen and Gunnarsson-Ostling, 2009; Neufeldt *et al.*, 2010; VijayaVenkataRaman *et al.*, 2012). Mitigation priorities and adaptation measures are complementary and can offer

1 co-benefits if they are addressed simultaneously (McEvoy *et al.*, 2006; Wilbanks and Sathaye, 2007; Klein *et al.*,
2 2007; Ayers and Huq, 2009; Laukkonen *et al.*, 2009; Neufeldt *et al.*, 2009; Preston *et al.*, 2011).

3
4 A variety of efforts around the world demonstrate the potential for integrating mitigation and adaptation. For
5 example, Tokyo's urban greening policies promote the development of green roofs and urban gardens in order to
6 address urban heat islands by acting as carbon sinks and urban flooding by reducing stormwater runoff and
7 moderating building temperatures (Laukkonen *et al.*, 2009). Similarly, Hamin and Gurrán (2009) note how the
8 development of renewable energy resources in Cornwall UK and Aspen/Pitkin County, USA not only reduce
9 greenhouse gas emissions, but reduce vulnerability to storm events and peak demand during periods of extreme
10 temperature by generating power through smaller and more decentralized means (Hamin and Gurrán, 2009). Despite
11 complementarity, it is essential to consider the full range of alternatives and impacts as mitigation and adaptation
12 measures also can be in conflict with each other. For instance, in the case of city center redevelopment in Byron
13 Shire, Australia, mitigation policies recommended high density development to achieve energy efficiency while
14 adaptation policies recommended more open spaces to buffer stormwater runoff and protect ecosystems and
15 conserve biodiversity (Hamin and Gurrán, 2009).

16
17 Integrating adaptation and mitigation can produce important co-benefits with biodiversity conservation (Berry,
18 2009; Mawdsley *et al.*, 2009; Vignola *et al.*, 2009; Bradley *et al.*, 2012). For example, one adaptation strategy is to
19 link isolated habitats together to form new suitable climate zones that can subsequently be linked to form climate
20 resilient ecosystem networks (Lovejoy, 2005; Vos *et al.*, 2008). This strategy allows for species to cope with and
21 adapt to a changing climate while unifying disparate parcels into larger areas that can better facilitate carbon
22 sequestration. Furthermore, the conservation of forests can aid mitigation by sequestering carbon and promote
23 adaptation by protecting ecosystem services. (Guariguata *et al.*, 2008; Paterson *et al.*, 2008; Locatelli *et al.*, 2011;
24 Wertz-Kanounnikoff *et al.*, 2011). A project in the Chinchiná watershed of Colombia was able to promote
25 reforestation while also controlling soil degradation and implementing agroforestry and silvo-pastoral systems that
26 created new income opportunities for local inhabitants (Locatelli *et al.*, 2011). Similarly, the Scolel Té project in
27 Chiapas, Mexico, is an example of a locally-supported carbon offset project that had around 60% of the carbon sale
28 price going to the farmer. This revenue then went to cover costs of establishing further agroforestry activities and for
29 supplementing livelihood needs (Nelson and de Jong, 2003; Locatelli *et al.*, 2011)

30 31 32 *14.2.2.2. Integrating with Development*

33
34 Developing countries are striving to improve the quality of life for their populations by taking actions reduce
35 poverty and provide an adequate standard of living. However, climate variability and increases in natural hazards
36 have the potential to undermine these goals (UNEP, 2011; Dupont, 2008; Kuwali, 2008). For instance, increased
37 precipitation can contribute to increases in flooding and exposure to toxins and diseases in areas that lack
38 appropriate drainage and sanitation services. Alternatively, droughts may emerge as increases in temperature lead to
39 increasing rates of glacial melt or as regions experience reductions in precipitation (IPCC, 2012). In these situations,
40 the poor may have difficulty obtaining access to water, as supplies become scarce (Kovats and Akhtar, 2008).
41 Mainstreaming adaptation into national and regional development policies offers a means to address vulnerability to
42 climate change while still maintaining progress in achieving economic and human development goals (Chuku,
43 2010). In fact, for many nations, the relationship between adaptation and development is so pressing that a wide
44 variety of existing development issues are being reframed in the context of climate adaptation (Lemos and Dilling,
45 2007).

46
47 Sustainable development is a distinct and holistic approach to development that seeks to balance economic,
48 ecological and social issues. Climate change and sustainable development often are considered to be two separate
49 agendas. However, they too have the potential to be complementary and mutually reinforcing. This complementarity
50 derives from the fact that climate adaptation initiatives can reduce vulnerability while promoting economic,
51 ecological, and social goals and objectives associated with development (Eriksen and O'Brien, 2007; Ayers and
52 Huq, 2009; Ayers and Dodman, 2010). At the same time, the promotion of issues such as food security,
53 environmental quality, and health and sanitation associated with development, can be made more sustainable and

1 equitable over the long term by accounting for projected climate impacts (Tanner and Allouche, 2011; Mooney *et*
2 *al.*, 2009).

3
4 The term sustainable adaptation has been advanced to emphasize the potential co-benefits that can be derived when
5 development and climate adaptation are seen as complementary (O'Brien and Leichenko, 2007). Despite the
6 potential for synergies to exist, adaptation efforts do not always attend to the environmental, social, and economic
7 consequences of action. For example, in some situations adaptation has inadvertently reinforced traditional gender
8 roles (Carr, 2008) and inequalities (Eriksen and Lind, 2009). In addition, according to Turner *et al* (2010),
9 adaptations such as building dams, migrating from water stressed to less developed areas, and exploiting natural
10 resources in times of stress will have negative impacts on biodiversity conservation. By linking adaptation and
11 sustainability, there will be greater sensitivity to equity, environment, and economic issues such as livelihoods when
12 seeking to advance climate adaptation.

13
14 The relationship between economic development and adaptation tends to be articulated somewhat differently in
15 developed and developing countries. In developed countries, adaptation plans and strategies often focus more on
16 infrastructure, particularly in relationship to transportation and utilities (Ford *et al.*, 2011), and rely on large-scale,
17 complex, and capital intensive engineering and technological solutions (Sovacool, 2011). Developing countries, on
18 the other hand, tend to be more concerned with integrating adaptation strategies with poverty and vulnerability
19 reduction (Eriksen and O'Brien, 2007; Mertz *et al.*, 2009; Hertel and Rosch, 2010), including those that promote
20 basic service provision and delivery (Satterthwaite *et al.*, 2009; Bauer and Scholz, 2010), food and water security
21 (Nath and Behera, 2011), and education and health care (Smit and Wandel, 2006; Eriksen and O'Brien, 2007;
22 Brauch, 2008; Perch-Nielsen *et al.*, 2008; Halsnaes and Traerup, 2009; Scott and Becken, 2010). Given this North-
23 South difference, while adaptation planning must ensure that development plans are robust against climate hazards
24 and disasters in all socioeconomic and development contexts, this nexus is especially critical in the most vulnerable
25 countries and least developed locations (ADB and IFPRI, 2009).

26 27 28 *14.2.2.3. Integrating with Disaster Risk Reduction*

29
30 Climate adaptation and disaster risk reduction (DRR) share the common goals of reducing vulnerability of areas and
31 populations to the impacts of extreme events while creating sustainable strategies that limit risks from hazards
32 (Solecki *et al.* 2011; Schipper, 2009; IPCC, 2012). Given that both fields seek to reduce vulnerabilities and build
33 capacity (Solecki *et al.*, 2011), integrating adaptation and DRR offers a number of co-benefits. Furthermore, a
34 combination of adaptation and disaster risk reduction strategies can reduce the risk of climate extremes and disasters
35 while also increasing resilience against remaining risks as they change over time (IPCC, 2012). For instance, DRR
36 can become more robust by considering climate change projections and assessments when planning measures to
37 reduce impacts. Further, many rural and subsistence communities are aware of climate change, but do not
38 distinguish between climate impacts and events and stressors that affect their lives and livelihoods. Integrating
39 adaptation and DRR, will ensure that the climate predictions and scenarios are considered when planning for
40 disasters and extreme events (Mercer, 2010).

41
42 Given the synergies between adaptation and DRR, some cities and communities have begun to explore the linkages
43 between these two areas. However, integration remains limited, particularly at the national level. Drawing on
44 reviews of plans, as well as expert interviews conducted in Germany, the United Kingdom, and Fiji, Birkmann and
45 Teichman (2010) found that despite having national adaptation plans that noted the importance of linking adaptation
46 and DRR, little action was taken at the national level to establish working relationships. Though effective integration
47 has yet to be substantively promoted at the international or national levels, adaptation and disaster risk reduction
48 may utilize local knowledge to better plan for extreme weather events and to uncover important existing local
49 capacities (IPCC, 2012).

50
51 Climate change is one of many stressors that governments and communities must address (Willbanks and Kates,
52 2010; Mercer, 2010). At the same time, adaptation is increasingly recognized as being linked to the development
53 paths of both developed and developing countries (Agrawala, 2005; Stern, 2006; Nelson *et al.*, 2007; Agrawala and
54 van Aalst, 2008; Ayers and Dodman, 2010; Willbanks and Kates, 2010). Since DRR has a long history of being

1 associated with development, more comprehensive efforts are being called for in order to bridge adaptation, disaster
2 management, sustainability, and economic and social development needs (Willbanks and Kates, 2010; IPCC, 2012).
3 By adopting a broader perspective, countries, states, and communities can address multiple stressors and multiple
4 vulnerabilities while building adaptive capacity (Willbanks and Kates, 2010; Solecki *et al.*, 2011). Moreover, the
5 most effective strategies that simultaneously contribute to adaptation and disaster risk reduction are those that
6 provide short-term developmental gains while helping to build long-term climate resilience (IPCC, 2012).
7
8

9 *14.2.2.4. Integrating with National and Local Policy and Planning*

10
11 Countries have pursued different approaches to integrating adaptation priorities with existing planning processes
12 (see Keskitalo, 2010). Some have chosen to produce stand-alone climate adaptation plans and strategies. These
13 include Finland's National Strategy for Adaptation to Climate Change (Marttila *et al.*, 2005; Juhola *et al.*, 2011),
14 Germany's Strategy for Adaptation to Climate Change (BMU, 2008), and Burkina Faso's submission to the National
15 Adaptation Programmes of Action (Kalame *et al.*, 2011). Although these stand-alone plans are administered through
16 one central ministry or department, they explicitly address integrating adaptation into areas and sectors such as
17 agriculture, water resources, land use, and transportation (Biesbroek *et al.*, 2010; Kalame *et al.*, 2010). In addition,
18 some countries have begun to integrate adaptation into their sector plans. For example, Australia's National
19 Agriculture and Climate Change Action Plan seeks to promote the development of a sustainable, competitive, and
20 profitable agricultural sector while also recognizing the need to pursue adaptation strategies and build resilience
21 (DAFF, 2006). Despite these examples, incidences of successfully mainstreamed adaptation into national planning
22 lag behind those at local and sub-national levels (Ford *et al.*, 2011).
23

24 Local governments are responsible for ensuring the safety, security, and well-being of their residents through efforts
25 including the provision of infrastructure and basic services, preparedness for emergency response, and protection of
26 environment quality and biodiversity. Of particular importance at the local level is addressing adaptation in the
27 context of land use planning. Adaptation can be integrated into these and other activities as well as into local
28 policies and plans (Dodman and Satterthwaite, 2008; Corfee-Morlot *et al.*, 2011; Measham *et al.*, 2011) and then be
29 implemented using existing institutional structures and processes (Wheeler, 2008; Kithiia and Dowling, 2010).
30 Many local governments are making strides in advancing an adaptation agenda (Rosenzweig, *et al.*, 2010; Carmin,
31 *et al.*, 2012), but mainstreaming is proving to be a challenge in many locations (Carmin, *et al.*, 2012). In order for
32 local governments to integrate adaptation with their policies, plans, and ongoing activities, there must be adequate
33 political support, capacity, commitment, and resources (Dodman and Satterthwaite, 2008; Seto *et al.*, 2010;
34 Amundsen *et al.*, 2010; Corfee-Morlot 2011; Carmin *et al.*, 2012), along with reliable local information (Dessai *et*
35 *al.*, 2005; Amundsen *et al.*, 2010; Measham *et al.*, 2011).
36
37

38 *14.2.3. Challenges in Adapting*

39
40 If adaptation actions are to be effective in reducing and managing the risks associated with a changing climate there
41 are a number of challenges that need to be addressed. The sections that follow summarize the most important
42 challenges and discussed in more detail in Chapters 15 and 16. Among the challenges that must be overcome are
43 scaling up, institutional mismatches, financial resource and capacity limitations, and the availability of information
44 and models that support decisions
45
46

47 *14.2.3.1. Scaling Up*

48
49 An ongoing challenge that nations, regions, cities and communities face is moving from ideas to action. Scaling-up
50 in the context of climate adaptation refers to transitioning from isolated projects and activities to comprehensive
51 initiatives. Top-down and bottom-up approaches to adaptation can both be scaled-up. The former can take advantage
52 of intergovernmental coordination both within and across levels of government and the potential to bring adaptation
53 to existing and new policies. In contrast, the latter can advance projects from one-off activities to programmatic

1 modes of action, both within a community as well as across communities and regions (Reid *et al.*, 2010; Urwin and
2 Jordan, 2008).

3
4 Scaling up of adaptation usually requires integration with other activities. It is more difficult for stand-alone models
5 of adaptation to achieve widespread adoption as governments are rarely willing or able to allocate special resources
6 to them (Huq and Reid, 2004; Handmer *et al.*, 1999; Morduch and Sharma, 2002; Huq *et al.*, 2003). In contrast
7 adaptation activities that build upon existing programs can be more effective. The Productive Safety Net in Ethiopia
8 combines an existing long-term workfare program that supports 6 million food-insecure households with scalable
9 safety nets that can be rapidly expanded during drought to cover millions of additional households based on the
10 triggering of a rainfall index (Hess *et al.*, 2006). Such safety nets can be combined with workfare programs that
11 undertake labour intensive public works, such as water storage, that will reduce vulnerability in the future (del
12 Ninno *et al.*, 2009).

13
14 Evidence is emerging to suggest that acceptance of a climate agenda and successful preparations for climate impacts
15 takes place when integrated into ongoing government initiatives (Nelson *et al.*, 2007; Agrawala and van Aalst, 2008;
16 Ayers and Dodman, 2010). For example, adaptation can be integrated into land use and water management sectors
17 (Werner *et al.*, 2010), the agriculture sector (Prabhakar and Srinivasan, 2011), urban storm water systems
18 (Gersonius *et al.*, 2012), or particular government plans and policies around infrastructure investment and disaster
19 resilience (Lasco *et al.*, 2009).

20 21 22 *14.2.3.2. Institutional Mismatches*

23
24 Mainstreaming action is contingent on government ministries and departments taking a long term view of changes
25 and challenges, integrating adaptation into their plans and agendas, and then working in a coordinated fashion to
26 realize these ends (Conway and Shipper, 2011). However, this level of coordination can be a challenge since many
27 adaptation issues cut across the jurisdictions and mandates of different government bodies and actors (Schipper,
28 2009). For instance, despite the importance of integrating adaptation and disaster risk reduction, legislation and
29 programs for disaster and climate management typically span different ministries and departments, each with their
30 own mandates, time horizons, priorities and agendas, all of which hinder coordination (Schipper and Pelling, 2006;
31 Birkmann and Teichman, 2010; Falaleeva *et al.*, 2011; IPCC, 2012)

32
33 Studies of decision making across levels of government have focused on mitigation and demonstrated how local
34 decisions are both facilitated and constrained by national level regulations, policies and institutions (Hooghe and
35 Marks, 2003; Betsill and Bulkeley, 2004). However, there also is evidence to suggest that the extent to which
36 national governments focus on and support adaptation can influence local level action (Urwin and Jordan, 2008).
37 For example, a survey of Norwegian municipalities (Amundsen *et al.*, 2010) found that local governments did not
38 have a clear idea or sense of their role with regard to adaptation policies and measures. The lack of familiarity with,
39 and attention to, adaptation was directly related to the limited focus given to this issue by the national government.

40
41 Adaptation assessment and planning requires the engagement of diverse actors (Lu, 2011). Local stakeholder
42 knowledge can complement expert views (Lane and McDonald, 2005; Crabbe and Robin, 2006; Corfee-Morlot *et*
43 *al.*, 2011; Huang *et al.*, 2011; Measham *et al.*, 2011) and enhance the design of adaptation strategies and policies by
44 ensuring that they capture local realities (van Aalst *et al.*, 2008). Engagement of local stakeholders also can lead to
45 participation in the subsequent implementation of adaptation initiatives (Gero *et al.*, 2011). Local governments often
46 find that there are institutional barriers to implementing participatory adaptation planning, including differences in
47 access by stakeholders to participatory decision making processes (Few *et al.*, 2007), lack of adequate and reliable
48 mechanisms for information sharing (Lwasa, 2010), and different knowledge, values, and perspectives shaping the
49 views and preferences of policymakers, experts, and the public (Veraat, 2010; Webb, 2011).

14.2.3.3. Financial and Capacity Limitations

Resources for adaptation have been slower to become available than for mitigation in both developed and developing countries. This has meant that there is less expertise in adaptation assessment and implementation, which is further confused by the lack of clarity about the distinction between adaptation and more common sustainable development and/or poverty reduction planning (Cruce, 2008).

Within developing countries only modest funding has been available for adaptation actions and much of this funding has been directed towards capacity building, standalone projects or pilot programs. Least Developed Countries were supported via the GEF resources to prepare NAPAs (see section 14.5.) prioritizing their immediate and urgent adaptation needs. However, funding to take action on these needs was slow to come and many governments were reluctant to move ahead without external support given the generally accepted responsibility of developed countries to support the incremental costs of adapting to climate change. The NAPAs were, in most countries, excellent opportunities to build technical capacity and institutional links, but with the long delays in moving to an implementation phase many of these skills dissipated (Ciplet *et al.*, in press).

There has been a significant increase in financial flows recently with replenishment of the GEF adaptation funds (LDCF & SCCF), support for the Pilot Program for Climate Resilience, and special purpose adaptation funds for UN Agencies, MDBs and major bi-lateral funds earmarked for adaptation. {Complete citations and a table of amounts nearer completion of the Report – currently LDCF USD224 million; SSCF USD130 million; Adaptation Fund USD 305-408 million; PPCR USD 970 million.} The Adaptation Fund, which is set up under the Kyoto Protocol and funded through a levy on most CDM projects, is of particular importance to developing countries as it is pioneering the direct access mechanism which allows countries to access funds without having to work through a multi-lateral development agency. This mechanism has again bought home the need to build and maintain capacity, not just in the technical aspects of adaptation assessment and project design but also in financial management and due diligence (Brown *et al.*, 2010).

14.2.3.4. Availability of Information, Data, and Models Needed for Action

Access to appropriate information and modeling tools is frequently identified as a major limitation to adaptation action by practitioners and stakeholders (World Bank, 2010). The Nairobi Work Program, established at COP12 in 2006 with a goal of helping developing countries making “informed decisions on practical adaptation actions and measures to respond to climate change on a sound scientific, technical and socio-economic basis” has made repeated calls for better observation systems, information sharing and modeling capacity (e.g. UNFCCC/SBSTA/2008/3). OECD recognized the need for improved information services if adaptation is to be better integrated into development planning (OECD, 2009). Developed and developing countries have acted upon this priority by establishing institutions to provide information services at national (e.g. UK Climate Impacts Programme in the United Kingdom (UKCIP 2011) and National Climate Change Adaptation Research Facility in Australia (NCCARF, 2012), regional (e.g. Caribbean Community Climate Change Centre in the Caribbean (CCCCC, 2011) and the EU xxx), and global scales (e.g. World Meteorological Organization (WMO, 2011) and World Bank Climate Knowledge Portal (World Bank, 2010)). The scientific community has supported these calls (e.g. Füssel & Klein, 2006, Wilby et al 2009).

The types of information can be classified broadly as past, current and projected biophysical and socio-economic information (Moss, to appear); information on adaptation options (de Bruin *et al.*, 2009; Patt *et al.*, 2010) including technologies and costs (UNFCCC, 2006; World Bank, 2010, 2011); and sharing of experience (UNDP, 2012). A lack of information and tools to support decision-making is often a costly and time consuming, early step in many assessments and project design processes particularly in developing countries (World Bank, 2010). In some cases a supposed lack of information may be used as a rationale for inaction on adaptation (Moser, 2010).

A challenge is to balance the quantity and complexity of information made available and the need to communicate clear guidance that best serves the purposes of stakeholders (UKCIP, 2011). This has been particularly the case in providing access more precise estimates of changes in climate and weather patterns at given location and times

1 (Wilby, 2009). Christensen *et al.* (2012) have explored this issue across the Arab countries, a region usually
2 understood to be lacking such information. A thorough review shows that observational hydro-meteorological data
3 are sparse compared to world standards, but the shortfall is made worse by recording stations not being entered into
4 global databases and by restrictions on access arising from security concerns. They also found good coverage of
5 downscaled climate information but point to the need to work closely with end users to assist them in interpreting
6 these data and incorporating them in impact modeling and decision processes.
7
8

9 **14.3. Synthesis of Adaptation Needs and Options**

10
11 The recommended adaptation process is based on identifying needs that stem from climate risks and vulnerabilities,
12 selecting options that promote adaptive capacity, and then implementing the chosen actions. The driver for
13 adaptation stems from the threats that different systems face while action is predicated on the extent to which they
14 are vulnerable or able to adapt. Often, identification of needs is rooted in assessments of different systems that, in
15 turn, make it possible to generate options and determine appropriate actions.
16
17

18 **14.3.1. Identification of Adaptation Needs**

19
20 Adaptation involves building the capacity of nations, regions, cities, communities and individuals, groups to cope
21 with climate impacts as well as mobilizing that capacity by implementing decisions and actions (Tompkins *et al.*,
22 2010). Adaptation requires that there is adequate information on what and how to adapt (Füssel and Klein, 2006).
23 Consequently, the foundation for generating adaptation options and building capacity is the identification of
24 adaptation needs. More often than not, this process of identifying needs is rooted in a formal assessment.
25

26 A number of different methods are used to assess climate risks and vulnerabilities, each having different orientations
27 and strengths and weaknesses (See 14.2.1.1. and Füssel and Klein, 2006). One approach is the risk-hazard
28 framework. Drawn primarily from risk and disaster management, this approach focuses on the adverse effects that
29 natural hazards and other climate impacts can have on a given location (Füssel and Klein, 2006). The emphasis in
30 this approach is on the physical and biological aspects of impacts and adaptation (Burton *et al.*, 2002). A second
31 approach, which is rooted in a political economy perspective, examines the ways in which individuals, groups and
32 communities are vulnerable to climate impacts. Here, the focus is on social vulnerability, with an emphasis on how
33 structural factors such as institutions shape socioeconomic conditions that place human populations at risk (Blaikie
34 *et al.*, 1994; Adger and Kelly, 1999).
35

36 Adaptation policy has to be responsive to a wide variety of economic, social, political, and environmental
37 circumstances (Burton *et al.*, 2002). Institutions with responsibility for progressing adaptation agendas will usually
38 also have responsibilities for other non-climate related agendas (O'Brien & Leichenko, 2006) Therefore, a more
39 integrated approach that has emerged that joins major elements associated with the risk-hazard and political
40 economy perspectives (Füssel and Klein, 2006). This combination considers a range of climate impacts while
41 placing an emphasis on the adaptive capacity of systems and populations (Heltberg *et al.*, 2009). By integrating
42 these approaches, it becomes possible to identify a broad spectrum of adaptation needs and then to draw on this
43 information to select appropriate options.
44

45 Assessments are becoming more holistic in their consideration of risks and socio-economic systems, but they still
46 tend to focus on specific levels government and specific sectors (Fekete *et al.*, 2010), even though adaptation needs
47 and options should account for the cross-cutting nature of climate impacts. Cross-level and cross-sector analyses
48 offer important vantage points, but also come with some important tradeoffs. For instance, local level assessments
49 offer detailed and often high quality information that captures complexity, but typically it is highly specific and
50 limited in transferability. Sub-national data provides insight into large-scale patterns as well as offers insight into
51 intermediate levels of analyses and processes. However, this level of aggregation makes it impossible to identify
52 many vulnerabilities and validation is a challenge. Finally, national assessments are useful for allocating global
53 funds, particularly in hazard prone regions, but there is little sensitivity to root causes (Fekete *et al.*, 2010). In

1 addition to up and down-scaling information within a given domain, moving across levels can be difficult translate
2 when spanning natural systems, social dynamics, and institutional processes.
3
4

5 *14.3.1.1. Institutional Needs*

6

7 Institutions and institutional actors are integral to reducing vulnerability as they shape the distribution of climate
8 risks, establish incentive structures that can promote adaptation, foster the development of adaptive capacity, and
9 establish protocols for both making and acting on decisions (See 14.2.3.2 and Agrawal, 2010). At the international
10 level, institutions and institutional actors offer adaptation resources and capacity support to developing countries. In
11 many instances, international and national-level policies and programs can facilitate localized strategies through the
12 creation of legal frameworks and the allocation of resources (Adger 2001; Corfee-Morlot *et al.*, 2009; Bulkeley and
13 Betsill, 2005). However, local governments have the potential to directly enhance the adaptive capacity of
14 vulnerable areas and populations by developing regulations including those related zoning, stormwater management
15 and building codes and attending to the needs of vulnerable populations through measures such as basic service
16 provision and the promotion of equitable policies and plans (Adger *et al.*, 2003; Nelson *et al.*, 2007; Brooks *et al.*,
17 2005). In the course of specific actions, local governments influence vulnerability and capacity by shaping access to
18 resources and structuring individual and collective responses to climate impacts (Agrawal, 2010).
19

20 While some approaches to assessment identify institutional needs, there are four general design challenges that
21 typically need to be addressed: adjusting to changing conditions, adopting a climate lens in ongoing activities,
22 facilitating intergovernmental coordination, and attending to the needs of diverse stakeholders (Gupta *et al.*, 2010;
23 Agrawal, 2010). First, institutions should be designed so that they are flexible. The uncertainty associated with
24 climate change and the availability of changing information and conditions, along with emerging ideas on how best
25 to foster adaptation, requires experimentation, a willingness of governmental and nongovernmental actors to learn
26 from both successes and mistakes, and to integrate this information into regulations, policies, plans, and ongoing
27 activities.
28

29 Second, in keeping with the notion of mainstreaming, adaptation would need to become an integral aspect of
30 policymaking, planning, and program development. Existing policies and plans may have the potential to support
31 adaptation, but can be constrained in their ability to achieve this end. This may be the case due to misaligned
32 instruments and timeframes within a given policy. Rather than focusing on short-term climate variability and
33 disaster-response, government actors need to adopt a long-term perspective in order to address vulnerability
34 reduction and promote the development of adaptive capacity (Conway and Shipper, 2011). A further issue with
35 regard to mainstreaming adaptation into institutions is that policies that address the same issue, but at different
36 scales, can result in conflicting aims and outcomes. An alternative is to re-calibrate existing policies and to
37 incorporate climate resilience in new policies, plans and programs so that they advance adaptation planning (Urwin
38 and Jordan, 2008).
39

40 Even if ministries or departments commit to addressing adaptation in the course of their ongoing activities, this
41 remains a challenging issue for both national and local governments to achieve. In many instances, a single
42 governmental body is not equipped to deal with a given climate impact while in other instances there are both gaps
43 and overlaps in institutional mandates, conflicting time horizons, and multiple actors involved in decisions and
44 actions (Sietz *et al.*, 2011; Hulme, 2009; Urwin and Jordan, 2008; Schipper, 2009; Adger *et al.*, 2005). As a result, a
45 third challenge is designing institutions so that they facilitate foster coordination, communication, and cooperation
46 (Schipper, 2009; Conway and Shipper, 2011; Agrawal, 2010). This should take place within levels of government,
47 across levels of government, and both within and across sectors. Coordination and communication are central to
48 adaptation since they not only affect efficiency and effectiveness, but also influence the allocation of resources
49 within and across governmental bodies as well as to numerous nongovernmental entities (Agrawal, 2010).
50

51 Further, in order to promote adaptive capacity, institutions would need to attend to the needs of diverse stakeholders
52 and foster means their engagement in adaptation decisions and actions. Top-down and bottom-up approaches each
53 provide important information and views. The former can adapt existing policies and plans and establish protocols
54 for mainstreaming adaptation into government initiatives (Urwin and Jordan, 2008). However, the latter approach

1 offers a means for ensuring that diverse viewpoints are heard and integrated into measures in ways that enhance
2 capacity. This not only requires that institutions are designed to encourage participation, but that they foster
3 learning, promote the development of leadership qualities, and support fair governance principles (Gupta *et al.*,
4 2010).

7 *14.3.1.2. Social Needs*

8
9 There are numerous barriers to implementing adaptation including natural, structural and institutional factors such as
10 the inability of natural systems to adapt to the rate and magnitude of climate change and constraints associated with
11 technology, finances, and political dynamics (Grothmann and Patt, 2005; Yohe and Tol, 2002). They also include
12 social, cultural, and individual factors, including values, identity, cognitive denial, and behavioral opposition. While
13 adaptation often focuses on “hard” measures, such as those rooted in technology and engineering, fostering resilient
14 settlements and societies means not only attending to basic needs such as the availability of food and water, but also
15 addressing social and psychological needs (Reser and Swim, 2011; Adger *et al.*, 2009; O’Brien, 2009; Frank *et al.*,
16 2010).

17
18 Climate vulnerability is rooted in the ability of individuals and groups to cope with the impacts of climate change.
19 At the individual level, women, the elderly, those with health challenges and disabilities, low social, minority, and
20 class status are among the least able to cope with threats from climate impacts (Adger *et al.*, 2009; Smit *et al.*,
21 2001). These individual factors also are often associated with and compounded by community-level conditions.
22 Many poor and ethnic minorities live in substandard housing, lack access to basic services, have compromised
23 health, and are at threat due to excessive densities, poor access roads, and inadequate drainage (Moser and
24 Satterthwaite, 2010; Huq *et al.*, 2007; Shikanga *et al.*, 2009; Kovats and Akhtar, 2008; Revi, 2009; Baker, 2011). In
25 rural areas, adaptation needs also are linked to the viability of agricultural activity (Bosello *et al.*, 2009).

26
27 In addition to social conditions, social psychological factors affect needs and adaptation capacity. For instance,
28 based on a study of coffee farmers, Frank *et al.* (2010) found that social identity, particularly social group
29 differentiation, ethnicity, and marginalization, shapes views of the credibility of information and perceptions of risk.
30 These views and perceptions, in turn, affected the willingness of farmers to adapt their growing practices. Further, in
31 a study of the response of the elderly to heat waves, Wolf *et al.* (2010) found that the bonds forged in social
32 networks shape perceptions of vulnerability through the narratives that were communicated. Their findings suggest
33 that vulnerability can either be reduced or enhanced, depending on the types of information that are disseminated
34 through networks. Overall, these findings demonstrate that individual perceptions and social ties influence
35 adaptation needs and measures.

36
37 The causes and solutions of vulnerability take place at different social, geographic, and political scales (Ribot,
38 2010). Therefore, in order to identify critical needs of populations, and the underlying conditions giving rise to these
39 needs, social assessments are best conducted across institutional domains and by spanning from the local to the
40 national. Local assessments provide a means to identify existing vulnerabilities as well as policies, plans, and natural
41 hazards contributing to these vulnerabilities. More specifically, at this level, social needs can be evaluated in terms
42 of availability of natural, physical, human, political, and financial assets, stability of livelihood, and livelihood
43 strategies (Moser, 2006; Heltberg *et al.*, 2008). Alternatively, regional and national assessments can provide a basis
44 for ascertaining institutional conditions associated with long-standing inequities and development paths that may
45 need to be addressed in order to generate robust options.

46
47 People often feel powerless when faced with significant threats such as climate change. New institutions may be
48 needed that address this sense of powerlessness, not only by enabling people to feel connected (O’Brien *et al.*,
49 2009), but also by addressing conditions that are entrenching socioeconomic and political inequities (Lemos and
50 Thompkins, 2008). Technological measures are integral to protecting populations, but institutional strategies need to
51 be pursued in order to ensure that the most vulnerable are able to cope with short and long term climate impacts
52 (Gupta *et al.*, 2010). Across levels of government, this means redesigning and implementing regulations, standards,
53 and other institutional protocols that reduce exposure to disasters and other impacts of climate change while at the
54 local level it means attending to basic and infrastructure services associated with development.

14.3.1.3. Ecosystem Services and Environmental Needs

It has been observed that climate change is exacerbating the already existing adverse consequences and impacts of anthropogenic activities on the sustainability of biotic resources (Mooney *et al.*, 2009, Vorosmarty *et al.*, 2010). The impacts of climate change on biotic resources and their interactions may be looked at in terms of the capacity of ecosystems to deliver essential services. In order to sustain ecosystems services, there is a need for improved methods for tracking and monitoring, and modeling ecosystem changes (Davin and de Noblet-Ducoudre, 2010), better understanding of the biological processes and interactions critical in the delivery of ecosystems services, and the creation of new tools and approaches for maintaining and restoring biological diversity (Scholes *et al.*, 2008; Mooney *et al.*, 2009).

14.3.1.4. Financial and Capacity Needs

As discussed elsewhere in this Report (Sections 3.2.1.1.4 and 3.2.3.3; Chapter 17) estimating the financial needs to achieve effective and equitable adaptation to climate risks has proven a difficult task. AR4 did not provide estimates of the costs but concluded that most case studies showed high benefit cost ratios for most adaptation activities. Recently, in response to the negotiations of under the UNFCCC a series of estimates have emerged. These range from about USD10 billion to USD40 billion per year to climate proof² development in developing countries (World Bank, 2006; Stern, 2006), which were revised upwards to USD80 billion and higher under revised assumptions (Oxfam, 2007) and new sectors. Two intensive studies by the UNFCCC and the World Bank came to estimates within the same range for developing countries (UNFCCC, 2007; World Bank, 2010), however the distribution of those costs across sectors differs significantly. The UNFCCC estimate for the costs in developed countries was USD20 billion to USD100 billion. The core conclusion from these studies was that the costs of adaptation are of the same order of magnitude as those for mitigation although the distribution of these costs between the public and private sectors is not clear (IIED, 2009).

[FOOTNOTE 2: The phrase ‘climate-proofing’ is not well defined, but in the context of adaptation may be taken to mean ensuring the sustainability of investments over their entire lifetime by explicitly taking into account a changing climate (Sveiven 2010). Methods for doing this vary greatly (see Section 14.2.1.1.4).]

A challenge at both the international and national levels is to develop financial instruments that are equitable in both their delivery of resources and the sharing of the burden in supporting the instruments. Burden sharing at the national level lies at the core of the negotiations over mitigation actions, but has been less thoroughly examined in the context of adaptation (Chapters 1& 6, Levina, 2007; World Development Report, 2010; Section 17.xxxx). With the exception of the Adaptation Fund (section 14.2.3.3 and 17.xxxx) most financial instruments for adaptation have depended on voluntary contributions at the national level to bilateral or multilateral funds. Financial flows through these funds have fallen well below the sums identified by the above studies (OECD 2012) and are expected to remain so as many of the resources will flow through the private sector (Agrawala *et al.*, 2011). Private sector funding will include not just current risk spreading instruments, such as insurance and contingent lending arrangements, but expenditures by the full range of private actors, from multi-national to SMEs (small-to-medium-enterprises) and small farmers, to protect their activities and supply lines from climate risks and to pursue new opportunities arising from a changing climate. Also, financial mechanisms for disaster risk management are also inextricably linked with those for adaptation (Mechler *et al.*, 2010) and mechanisms for adaptation will have to balance immediate needs for essential development and disaster recovery with longer term goals directed to climate resiliency.

The Cancún Agreement calls on developed countries to provide new and additional resources for climate actions with USD30 billion over the 2010-2012 period and a longer-term goal of USD100 billion per year by 2020, but with the share going to adaptation still undetermined. While efforts to integrate climate change adaptation will be led by developing country partners, international donors have a critical role to play in supporting such efforts as well as in integrating consideration of adaptation within their own plans and activities (OECD, 2011).

1
2 Payments required in the future for climate change will equal or dwarf those of current development expenditure
3 (Peskest *et al.*, 2009). Delivery channels will need to be designed to reach the poor who are also often most
4 vulnerable to the impacts of climate change. For example, for adaptation financing, working at the sub-national level
5 will be important and mechanisms like microfinance merit a closer look (Agrawala and Carraro, 2010). Another
6 important concern is that with new money being made available for climate change research, policy development,
7 and practice, people may place too much emphasis on addressing this as an isolated priority to the detriment of other
8 equally pressing social, economic, and environmental issues (Ziervogel and Taylor, 2008).
9

10 Capacity is not limited to finances alone, but extends to human, technological, informational, and social resources
11 (Yohe and Tol, 2001; Adger, 2006; Eakin and Lemos, 2006; Smit and Wandel, 2006). These issues are critical
12 capacity needs in all countries and regions, but become most pressing in local governments facing challenges at
13 attending to ongoing needs and demands. Experience in Durban, South Africa, for example, shows that local
14 government departments often have differing abilities to respond to climate challenges. As the city began pursuing
15 adaptation, some departments were able to mainstream adaptation-oriented activities into their ongoing work, while
16 others were struggling to cope with existing backlogs and to maintain business as usual and, therefore, did not have
17 the capacity to address climate-related concerns (Roberts, 2010).
18

19 *Capacity Section – TBC --*

20 *1) What are capacity needs; 2) Capacity development to foster bottom-up planning and (3) need have means to*
21 *maintain capacity. How do you make sure capacity stays – through regional institutional capacity building; south –*
22 *south practitioners networks. UNEP Report (2011) to appear soon – will build upon this. Also ACCCA 2009.*
23
24

25 **14.3.2. Options for Adapting to Climate Change**

26

27 Adaptedness to climate is a normal feature of societies, evident in cultures, norms and activities everywhere. In this
28 sense, adaptation to climate change includes not just tangible actions – such as the building of a higher river levee as
29 a precaution against changed risks of flooding – but also intangible adjustments – such as the changed landscape
30 values as a result of higher levees (Brander, 2011), or the changing sense of security of residents living behind the
31 levee. Options for (and limits to) adaptation therefore have tangible as well as intangible dimensions (O’Brien,
32 2009). Adaptation goals, and thus options, are always socially contingent, with actors having different sensitivities
33 to climate impacts, different personal goals, and different understanding of and attitudes towards risk (Adger *et al.*
34 2007; Stafford-Smith *et al.* 2011).
35

36 The universe of adaptation options includes adjustments that reduce perceived risks associated with climate change,
37 as well as adjustments that seek to enhance welfare and resilience (Doria *et al.*, 2009). Hallegatte (2009) defines five
38 broad strategies for adapting to climate change: (i) selecting ‘no-regret’ strategies such as climate-proofing buildings
39 and repairing leaks in water pipes produce desired benefits or outcomes whether regardless of whether climate
40 impacts occur; (ii) favoring reversible and flexible options; (iii) buying ‘safety margins’ in new investments such as
41 building higher sea walls or greater storm water drainage capacity; (iv) promoting soft adaptation strategies such as
42 the use of ecosystems to manage extreme flows; and (v) reducing time horizons over which decisions will apply.
43

44 Selecting specific adaptation options can be challenging partly due to the rate, uncertainty, and cumulative impacts
45 of climate change. However, such signals need to be interpreted and weighed against other cultural, economic,
46 political or social signals that may encourage change. Indirect signals from regulators or customers may be a
47 stronger signal to the agents responsible for adapting than the observed climate itself (Berkhout *et al.*, 2006). Also,
48 rarely will adaptation options be designed to address climate risks or opportunities alone (IPCC, 2007b), instead
49 actions will often be undertaken with other goals (such as profit or poverty reduction) in mind, while also achieving
50 climate-related co-benefits. Gains in reduced vulnerability, enhanced resilience or greater welfare will often be co-
51 benefits generated as a result of changes and innovations driven by other factors. Thus, rather than focusing on
52 adaptation options addressing specific dimensions of climate change, more attention is being paid to mainstreaming
53 climate change into wider government policy and private sector activities (Sietz *et al.*, 2011).
54

1 While the selection of adaptation measures must account for different stakeholder perceptions in light of the
2 potential to reduce vulnerability, other factors that should be considered are cost effectiveness, equity, co-benefits,
3 environmental impacts, sustainability, potential for scaling up and community acceptance (Martens *et al.*, 2009).
4 There will be divergent perceptions and opinions about these options, influenced by the range of attitudes that exist
5 about the goals of adaptation, risk and uncertainty, costs and benefits and so on. One of the main contributions of
6 recent research on adaptation has been to suggest that adaptation options, at least the majority of those that might be
7 expected over the short-term, are often ambiguous, contested and embedded in specific contexts.

8
9 The specific measures employed often are referred to as soft and hard. As discussed below, those in the former
10 category include institutional and social measures while those in the latter category tend to be those that rely on
11 technological and engineering solutions. It is important to note, however, that not all technological solutions are
12 'hard', as for example some of the changes in agricultural practice based on early warning systems and modeling.
13 Ecosystem-based adaptation, such as the maintenance of wetlands that protect against storm surges, or floodways to
14 manage extreme flows are often considered to be 'soft' measures, but are often linked with 'hard' measures such as
15 levies, drainage and silt-trapping structures.

16 17 18 *14.3.2.1. Institutional and Social Options*

19
20 Numerous institutional measures can be used to foster adaptation. These range from financial instruments such as
21 taxes, subsidies and insurance arrangements to social policies, to regulatory instruments such as building codes and
22 land use plans (Hallegatte, 2009; Heltberg *et al.*, 2009; de Bruin *et al.*, 2009). Informational strategies such as early
23 warning systems, education programs, and dissemination of climate information are integral to adaptation as are
24 measures designed to protect populations such as relocation and evacuation schemes. Numerous activities designed
25 to account for changing weather and precipitation patterns are taking place in many nations. However, as previously
26 noted, to ensure that that institutions provide an appropriate context for action, efforts must be made to coordinate
27 across agencies and departments (Schipper, 2009; Conway and Shipper, 2011; Agrawal, 2010) and to account for
28 stakeholder views and preferences while fostering widespread commitment and engagement (van Aalst *et al.*, 2008;
29 Few *et al.*, 2007; Gero *et al.*, 2011).

30
31 An institutional measure that provides support to the most vulnerable populations is social safety nets. For example,
32 long-term and child malnutrition have been associated with reduced adult earnings (Hoddinott, *et al.*, 2008;
33 Alderman, et al, 2009). Malnutrition often results from extreme weather events, particularly floods and droughts, as
34 both can alter the price or availability of food. While some studies have shown that food programs can be
35 counterproductive to promoting livelihood or may not prevent malnutrition in non-emergency situations (e.g.,
36 Bhutta, *et al.*, 2008), programs designed to provide support at times of extreme events can provide an important
37 bridge for vulnerable populations (Alderman *et al.*, 2010). Responding to disasters is important, but so too are
38 anticipatory initiatives. Pro-poor measures that foster health, nutrition, and education are no-regrets approaches that
39 can promote development while enhancing adaptive capacity (Heltberg *et al.*, 2009).

40
41 Effective governance is important for the efficient operations of institutions. In general, governance rests on the
42 promotion of democratic and participatory principles as well as on ensuring access to information, knowledge, and
43 networks. The basic premise is that robust governance measures can promote adaptation by building adaptive
44 capacity (Adger *et al.*, 2009). This argument is reflected in assessment of river-basin planning in Brazil, where
45 Engle and Lemos (2010) found that improving governance mechanisms appears to enhance adaptive capacity.
46 However, they also note that this is not a simple relationship as tradeoffs exist between different aspects of
47 governance that can make some approaches more or less appropriate for given contexts.

48 49 50 *14.3.2.2. Technological and Engineered Adaptations*

51
52 Technological adaptation measures in various sectors are being developed based on available knowledge and recent
53 advances in science and technology. In food and agriculture sector, for example, a suite of adaptation options are
54 developed and applied to reduce the adverse impacts of climate change on crop production. Wassmann *et al.* (2010)

1 have presented some adaptation measures in rice production. The alternate wetting and drying technology has been
2 shown to significantly improve water use efficiency and has also reduced methane emissions from rice fields. Sub1
3 rice variety, which is being tested in several regions in Asia, has been demonstrated to be flood-tolerant and can
4 withstand prolonged submergence with no significant yield reduction. Other adaptation measures in this sector
5 include innovations in good agricultural practices (GAPs) in several areas such as adjusting the cropping calendar
6 based on rainfall distribution or on simulated yield probabilities using process-based crop models under a
7 downscaled climate scenarios (Semenov, 2006; Semenov, 2008; Bannayan and Hoogenboom, 2008).

8
9 There are repeated calls for technology transfer to and sharing between developing countries in adaptation to match
10 the programs associated with mitigation (UNFCCC, 2006). However, the circumstances are different. Unlike
11 mitigation, where low-carbon technologies are often new and protected by patents held in developed countries, in
12 adaptation the technologies are often familiar and applied elsewhere. For example, agricultural practices that are
13 well known in a region some distance away may now be applicable but unfamiliar within a region of interest.

14
15 There are some technologies that may become more important in adapting to climate change. Improved water
16 transport and application through irrigation, or through water use efficiencies in industry all have particular
17 technologies that need to be more widely available, as will desalination technologies. Revised building codes are
18 another important opportunity to increase resilience to climate impacts, but again institutional issues such as
19 enforcement are just as important.

20
21 With the rapid diffusion of Information and Communication Technologies (ICT) such as mobile phones and the
22 internet, the unprecedented speed at which information is produced and shared is posing a new set of possibilities
23 and challenges to communication management and trust building, both essential to the development of resilience
24 and adaptation to the changing climate. ICT provides opportunities for both top-down dissemination of relevant
25 information such as weather forecasts, hazard warnings, market information, and advisory services. It can also
26 generate essential information through bottom-up processes such as ‘crowd sourcing’ of useful information such as
27 hazard warnings (e.g. local flood levels), disease outbreaks and the management of disaster responses.³ MacLean
28 (2008) identifies three kinds of effects of the rapid advances in ICT on adaptation and development in general: direct
29 use for monitoring and measuring climate change as described above; as a medium for raising awareness; and as an
30 enabler for a ‘networked governance’ based on networked open organisations.

31
32 [FOOTNOTE 3: See web sites of Ushahidi (<http://ushahidi.com/about-us>) and Ping
33 (<http://www.pingsite.org/index.php>) for on-going activities.]

34
35 Adaptation experiences suggest that vulnerable communities are more prone to act upon information that they can
36 trust, a complex concept that could be linked to factors such as the source of the information and the local perception
37 of it, the language used to convey the message, the role and credibility of ‘infomediaries’, and community
38 involvement, among others. Ultimately, ICTs could play an important supportive role helping to build and
39 strengthen trust within vulnerable communities.

40 41 42 *14.3.2.3. Ecosystem-Based Adaptation*

43
44 Climate change is altering ecological systems, biodiversity conservation, and resources associated with ecosystem
45 services (Hoegh-Guldberg, 2011; Mooney *et al.*, 2009). These systems not only are important for their own sake, but
46 because they contribute to human welfare on prosperity in the face of a changing climate. For instance, coastal
47 wetlands and coral reefs can help to protect against rising sea level (Hoegh-Guldberg, 2011) while the maintenance
48 of wetlands and green spaces can control run-off and flooding associated with increases in precipitation (Mooney *et al.*,
49 2009; Jentsch and Beierkuhnlein, 2008). Consequently, there is a need to protect these systems and resources
50 within the changing climate (Carpenter *et al.* 2009).

51
52 There are a number of options for ecosystem-based adaptation. In addition to policy and planning options, these
53 include integrative adaptive forest management (Bolte *et al.*, 2009; Guariguata, 2009; CBD, 2009), the inclusion of
54 climate change risk management and adaptation in agricultural and rural development activities (Reyer *et al.*, 2009),

1 land and water protection and management, and direct species management (Mawdsley *et al.*, 2009). Often, an
2 emphasis is placed on technological and engineered approaches to adaptation. However, working with nature's
3 capacity and pursuing ecological options, such as coastal and wetland maintenance and restoration, to absorb or
4 control the impact of climate change in urban and rural areas can be efficient and effective means of adapting
5 (Huntjens *et al.*, 2010).
6

7 Ecosystem-based adaptation may require trade-offs through managing ecosystems to provide particular services at
8 the expense of others. For example, to provide an effective wetland buffer for coastal protection may require
9 emphasis on silt accumulation possibly at the expense of wildlife values and recreation (CBD 2009). Given
10 uncertainties about how ecosystems will develop under multiple stresses and a changing climate an adaptive
11 management approach to ecosystem-based adaptation is expected to produce the best outcomes.
12
13

14 **14.4. Actors and Roles in Adaptation**

15

16 Climate adaptation requires the engagement of governmental, nongovernmental, and private sector actors across
17 levels and sectors. The identification of diverse needs, generation of appropriate options, and successful
18 implementation of adaptation measures is predicated on diverse actors contributing their views, ideas, and expertise.
19
20

21 **14.4.1. Local Actors and Roles**

22

23 *14.4.1.1. Local Governments*

24

25 Local governments are integral and critical actors in advancing adaptation and in shaping the options identified and
26 selected. As institutional actors, they influence the distribution of climate risks, mediate between levels of
27 government as well as between social and political processes, and they establish incentive structures that affect both
28 individual and collective action at all levels (Agrawal and Perrin, 2008). As a result, local governments have the
29 potential to strengthen the capacity of both the urban and rural poor through the acquisition and distribution of
30 finances, knowledge and information, skills, training, and technological support (Agrawal and Perrin, 2008)
31

32 Local governments consist of elected officials as well as individuals who work in government agencies and
33 departments, all of whom have the potential to thwart adaptation initiatives as well as to contribute to the
34 formalization and institutionalization of adaptation initiatives. Critical to both caretaker and facilitation roles are the
35 implementation of national mandates and the development of dedicated local policies. In addition to advancing
36 policies, these individuals are in a pivotal position to promote widespread support for adaptation initiatives, foster
37 intergovernmental coordination, and facilitate implementation, both directly and through mainstreaming into
38 ongoing planning and work activities (Carmin *et al.*, 2012; Anguelovski and Carmin, 2011).
39

40 Despite the critical role they play, local governments, particularly those in developing countries, are faced with
41 numerous challenges that limit their ability to identify needs and pursue adaptation options. Often, these
42 governments must attend to backlogs of basic and critical services such as housing and water supply or focus their
43 attention on addressing outmoded and outdated infrastructure. They also may lack institutional capacity or have
44 difficulty gaining coordination among departments as conflicts emerge to obtain scarce resources (Dodman *et al.*,
45 2009; Hardoy and Romero Lankao, 2011). Attending to each and every one of these issues may be integral to
46 advancing adaptation. However, government representatives may encounter roadblocks both from within their
47 communities as well as from other levels of government in setting priorities, obtaining and allocating resources, and
48 engaging in coordinated action if attention is oriented to adaptation rather than away from stated priorities.
49

50 Although they may encounter challenges, Roberts (2008) suggests that there are a number of indicators that
51 demonstrate whether local government has institutionalized and mainstreamed adaptation. Specifically, she suggests
52 that these include the presence of an identifiable champion from within government, climate change being an
53 explicit issue in municipal plans, resources are dedicated to adaptation, and adaptation is incorporated into local
54 political and administrative decision making (Roberts, 2008).

14.4.1.2. Households

As adaptation is local in nature, households play an important role in responding to climate impacts. At the farm level, for example, decision-making on farm activities and operations are made at the household level, and community or group of households. The identification of adaptation measures often involve household members including women and children (Sivakumar and Hansen, 2007; Sivakumar and Motha, 2007). Climate adaptation measures in this context consist of innovations to existing farm practices and operations from land preparation, crop and livestock management, harvesting and marketing. Adjusting the planting date is usually among the first decision to be made based on available knowledge and information (Lansigan *et al.*, 2007).

14.4.1.3. Indigenous Peoples

Indigenous actors can contribute in important ways to adaptation. In most regions of the world, indigenous knowledge exists about how and when to respond to climate change and climate variability. Alexander *et al.* (2011) noted that the complementarities between traditional ecological knowledge and scientific information include an increased ability to translate indigenous narratives to reflect patterns of regional change and the ability to produce expanded and multidimensional pictures of climate change impacts based in the context of human landscapes (Alexander *et al.*, 2011). For example, indigenous knowledge on climate adaptation in farming operations has been transferred from generation to generation and ranges from activities associated with land preparation to those regarding harvesting methods (Sivakumar and Hansen, 2007). Furthermore, in Southeast Asia, the practice of rice terracing in sloping and fragile mountainous ecosystems have been practiced since time immemorial (Sivakumar and Hasen, 2007; Sivakumar and Motha, 2007). The choice of crops to plant during a dry or wet year has been found to be successful in reducing the adverse impacts of climate change and variability (Lansigan *et al.*, 2007). Likewise, climate adaptation measures for smallholder agroforestry based on good practices in Southeast Asia has recently been documented (Lasco *et al.*, 2011).

In addition to drawing on their traditional knowledge of adaptation measures, indigenous actors can be engaged by regional and local governments to support and advance adaptation initiatives. For instance, agro-pastoralists in Makueni District, Kenya are involved in monitoring, assessing, and adapting to the effects of drought through observing local weather and wildlife behavior signs (Speranza *et al.*, 2010). In this case, indigenous peoples assess changes on the land in tandem with projection information from regional and ecosystem level climate models. Indigenous assessments are crucial for adding locally relevant climate impact information. However, because of preexisting poverty-related resource and capacity limitations, many indigenous communities continue to encounter difficulty in successfully implementing adaptation strategies (Speranza *et al.*, 2010).

14.4.1.4. Local Communities

Many communities pursuing adaptation are engaging community-based, civil society, and nongovernmental organizations in planning and implementation. One approach that relies extensively on communities and community organizations is community-based adaptation (CBA). CBA is characterized by the engagement of local residents in exercises designed to identify measures that can reduce vulnerability while building local adaptation capacity. CBA can both engage as well as empower residents to plan for and take action to address the impacts of climate change (Reid *et al.*, 2010; Ebi, 2008), but it relies on participatory processes and not only considers hazard prone areas, issues in service delivery, and gaps in infrastructure, but often attends to local social and cultural norms as a means to take a holistic approach to reducing vulnerability (Ayers and Forsyth, 2009). The outputs of these processes have included numerous recommendations and plans of action, including the design and implementation of early warning systems, infrastructure development, and improvements in service delivery (Ensor and Berger, 2009; Douglas *et al.*, 2008).

1 Communities have a long history of participating in vulnerability assessments and risk-mapping in the context of
2 disaster risk reduction (Yamin *et al.*, 2005; Larsen and Gunnarsson-Östling, 2009). Many of these ideas and
3 methods have carried over into adaptation initiatives as a means to identify climate-related hazards and risks (Van
4 Aalst *et al.*, 2008). For instance, CBA has been adopted in the Philippines and Bangladesh to plan for flood
5 reduction and disaster management (Ensor and Berger, 2009) as well as in cities such as Durban where local
6 communities are engaged in climate risk assessments and adaptation planning (Carmin *et al.*, 2012). These activities
7 are designed to foster the transition from assessment to planning to implementation and, in the process, to sensitize
8 communities to climate-related issues while promoting wide-spread adaptation action.
9

10 Community members also can contribute to local knowledge in support of government initiatives. For instance, in
11 efforts to address climate adaptation and sustainable resource management needs, local residents from the southwest
12 Yukon in Canada supported forest management plans by providing input on strategic benchmarks and design of
13 appropriate harvest activities (Ogden and Innes, 2009). Community engagement also has been used by governments
14 to ensure that local needs are. One example is the Government of Fiji which introduced a provision for including
15 disaster-affected communities in disaster assessments. Responsibility for surveying and assessing damage was
16 delegated to the affected communities. The information that was collected was then used to inform the design of
17 disaster response and recovery programs (Meheux *et al.*, 2010).
18
19

20 *14.4.1.5. Local Civil Society and Nongovernmental Organizations*

21

22 Civil society actors, including NGOs and community-based organizations, also contribute to adaptation, both
23 through dedicated initiatives as well as in the course of their ongoing work. NGOs have the potential to support
24 government action as well as to take independent action that facilitates adaptation beyond government programs.
25 Some programs are initiated by governments. For instance, in Quito, local NGOs receive funding from the
26 government to train indigenous farmers to improve water resource management, particularly in the context of urban
27 agriculture, diversify crops and privilege those that are native, and replant native tree species in hillside areas. The
28 NGOs also work with indigenous communities, teaching them to monitor variations in rainfall and flows from local
29 rivers and then sharing that data with municipal staff so that tracking of water levels is up-to-date (Carmin *et al.*,
30 2012; Anguelovski and Carmin, 2011).
31

32 Some programs are initiated by governments, while others originate from NGOs and CBOs. Cameroon, for example,
33 has low adaptive capacity with limited ties within and across levels of government. While many government
34 departments had limited awareness and were taking little to no action on climate change, Brown *et al.* (2010), found
35 that NGOs and other civil society organizations contributed to government capacity. In particular, they found that
36 while many NGOs working at the local level focus on sustainable development rather than climate change,
37 organizational representatives took advantage of the synergies in these two areas and were helping local residents
38 prepare for climate impacts (Brown *et al.*, 2010). As this example suggests, civil society actors can contribute to the
39 capacity of local governments and foster mainstreaming by supporting and promoting adaptation activities (Brown,
40 2010; Carmin *et al.*, 2012).
41
42

43 *14.4.2. District, State, and National Actors and Roles*

44

45 *14.4.2.1. District, State, and National Governments*

46

47 Governments at all levels play important roles in advancing adaptation and in enhancing the adaptive capacity and
48 resilience of diverse stakeholder groups. National governments are integral to advancing an adaptation agenda as
49 they can develop regulations and provide policy direction to district, state, and local governments. Drawing on an
50 analysis of published articles, Berrang-Ford *et al.* (2011) found that upper levels of government, particularly
51 national governments often used institutional mechanisms such as laws and policies to foster adaptation. In some
52 instance financial support was made available, particularly where adaptation was taking place at the national level.
53 In addition, the engagement of national government actors can help mobilize political will, support the creation and
54 maintenance of climate research institutions, establish horizontal networks that promote information sharing

1 (Westerhoff *et al.*, 2011) and, in some cases, facilitate the coordination of budgets and financing mechanisms (Alam
2 *et al.*, 2011; Kalame *et al.*, 2011). Although there are general trends in the impact that national actors have on
3 adaptation efforts, there also are differences in developed and developing countries. Among the key differences
4 noted are that higher income countries are more often include governmental engagement in planning and
5 implementation, focus on non-resource-based sectors, pursue long-term planning processes that include activities
6 such as building partnerships and research, and rely on institutional, governmental, and guideline-based protocols
7 (Berrang-Ford *et al.*, 2011).

10 14.4.2.2. National Civil Society and Nongovernmental Organizations

11
12 Civil society and nongovernmental organizations play critical roles in the climate adaptation agenda at different
13 levels of social hierarchy. CSOs and NGOs can fill roles associated with monitoring and evaluation, be instrumental
14 in information dissemination and awareness-raising, and stimulate individual and collective climate adaptation
15 actions (Martens *et al.*, 2009). They also can serve as catalysts and facilitators. For instance, while many
16 government departments in Cameroon had limited awareness and were taking little to no action on climate change,
17 Brown *et al.* (2010) found that NGOs and other CSOs contributed to national government capacity by enhancing the
18 ability to respond to new international policies, particularly with respect to climate change and forests.

21 14.4.2.3. Private Sector

22
23 The role of the private sector is fundamental in delivering adaptive changes. Most often, the focus falls on the role of
24 the private financial sector in providing risk management options, including insurance and finance for large projects
25 (see Chapter 15). However, the delivery of adaptation actions ranges more widely and spans different types of
26 private enterprise, from small farmers, to SMEs to multinational companies. As suggested by Figure 14-1, there are
27 three general ways in which the private sector can become involved in adaptation (Khattari, *et al.*, 2010). The first,
28 internal risk management is critical to firms and enterprises protecting their own interests and ensuring continuity.
29 The second form of involvement is recognizing that business is a stakeholder and therefore, participates in public
30 sector and civil society initiatives. One example of this type of engagement was the adaptation planning process in
31 New York City. As part of the initiative, The New York City Panel on Climate Change was established and
32 consisted of diverse stakeholders, including scientific experts and representatives from the private sector. In
33 addition, the New York City Climate Change Adaptation Task Force, consisting of representatives from government
34 agencies and the private sector was formed (Rosenzweig *et al.*, 2011).

35
36 [INSERT FIGURE 14-1 HERE]

37 Figure 14-1: A typology of private sector engagement in adaptation (Khattari *et al.*, 2010).]

38
39 Third, climate adaptation also provides new opportunities to the business community. In addition to fostering
40 cooperation across government departments, relationships and partnerships with the private sector and NGOs can
41 help to promote climate resilience and build the adaptive capacity of the urban poor. In an assessment of business
42 potential in the context of adaptation, Khattari *et al.* (2010) concluded that there were a wide range of opportunities.
43 In addition to financial instruments and risk management, they noted options for working in the healthcare, waste
44 and water management, sanitation, housing, energy, and information sectors (Khattari *et al.*, 2010). The opportunities
45 were based on their assessment of income potential in combination with enhancing adaptation in particular sectors
46 as well as in building the capacity of the urban poor.

47
48 KPMG (2008) sought to identify the sectors where businesses face the greatest risks. The core risks were identified,
49 in order of perceived importance, as regulatory, physical, reputational and litigation risk. The sectors identified as
50 most at risk included an expected cluster around oil & gas and aviation, and also a group less commonly perceived
51 to be at risk, including Health care, the financial sector, tourism and transport.

52
53 Despite some examples of private section engagement in adaptation, most assessments conclude that action in each
54 in each of the potential arenas has been slow to emerge (Khattari *et al.*, 2010). KPMG (2008) concluded that while

1 companies are well used to managing business risk they are yet to integrate the long-term risks of climate change
2 into these systems. Nor are they preparing to grasp the competitive advantages that will accrue to those taking early
3 action. Most of the private sector appears to be unaware of the scale of the threat and opportunities for their
4 businesses or are awaiting further guidance and action by governments. They have trouble in accessing and applying
5 information on the extent of the threats and impacts from climate change and have yet to engage in the detailed cost
6 benefit analysis of adaptive actions. Also, there are still questions of whether and how adaptation finance should be
7 made available to the private sector in developing countries (Persson et al, 2009; IFC, 2010) although this is being
8 piloted through the Pilot Program for Climate Resilience (World Bank, 2008; IFC and Asian Tiger Capital Partners,
9 2010).

10 11 12 *14.4.2.4. International Organizations and Institutions*

13
14 International organizations and institutions include intergovernmental organizations, multilateral and bilateral
15 agencies, multinational corporations, and nongovernmental organizations. These actors engage in a variety of
16 activities that affect adaptation at the international, national, and local levels. Among the roles played by
17 intergovernmental organizations is the formation of treaties and agreements and creation of international funding
18 mechanisms. For instance, the Adaptation Fund and the Nairobi Work Programme, among others, are international
19 institutions designed to facilitate adaptation at the national and regional levels (Ayers, 2009; Ayers and Huq, 2009;
20 Flam and Skjaereth, 2009; Hardee and Mutunga, 2009; Kalame *et al.*, 2011; Lu, 2011). Multilateral and bilateral
21 agencies typically focus on the provision of development assistance and the creation and implementation of capacity
22 building programs. Through these efforts, agencies allocate funds, transmit information, and disseminate
23 technology.

24
25 International NGOs, particularly international development, aid, and humanitarian organizations, have long histories
26 of working on adaptation-related activities. Organizations such as CARE and Red Cross/Red Crescent work directly
27 with communities to plan for water and sanitation as well as offer educational programs designed to provide
28 information about climate risks (Suarez *et al.*, 2008). Numerous development organizations work on issues related
29 to livelihood. Development initiatives not only have the potential to address poverty alleviation, but can reduce
30 vulnerability by promoting adaptive capacity (Burton *et al.*, 2002; Huq *et al.*, 2003). As a number of studies show,
31 while these activities may be oriented to promoting rural livelihoods in the context of environmental and
32 development projects, they have co-benefits of building local capacity and promoting adaptive responses that enable
33 communities to be better prepared to cope with climate impacts (Rojas Blanco, 2006; Pouliotte, 2009).

34 35 36 **14.5. International, National, and Sectoral Assessments**

37
38 *Need introduction on purposes and types of assessments. Should there be a section on the frameworks etc and*
39 *process of assessment?*

40 41 42 *14.5.1. National Communications to the UNFCCC*

43
44 Under the Convention, all Parties are encouraged (Annex 1 countries are required) to report on their activities in
45 relation to “vulnerability assessment, climate change impacts and adaptation measures” (FCCC/CP/1999/7). Parties
46 are encouraged to use the IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations
47 (Carter *et al.* 1994) and the UNEP Handbook on Methods for Climate Change Impacts Assessment and Adaptation
48 Strategies. Annex 1 countries are due to submit their 6th Communications by 2014 and most non-Annex1 countries
49 have submitted at least one Communication and some their second.

50
51 Non-Annex I Parties are encouraged to provide information their vulnerability to the impacts of climate change in
52 key vulnerable areas and, to the extent possible, an evaluation of strategies and measures for adapting to climate
53 change in key areas. The UNFCCC model for dealing with adaptation was to follow three phases; (i) identifying
54 possible impacts and options; (ii) measures to increase capacity; and (iii) measures to facilitate adaptation. There has

1 been concern whether the National Communications within developing countries are sufficiently well supported and
2 frequent to move through these stages as quickly as now appears necessary (Burton *et al.* 2002).

3
4 A stronger indicator of an increased recognition of the need for adaptation actions is the increase in its inclusion in
5 Poverty Reduction Strategy Papers (PRSP) that are prepared by developing countries through a participatory process
6 involving domestic stakeholders as well as development partners. PRSPs describe the country's macroeconomic,
7 structural and social policies and programs over a three-year or longer horizon to promote broad-based growth and
8 reduce poverty, as well as associated financing needs and sources. However, there is still an opportunity for better
9 integration of the PRSPs with NAPAs and, in the future, presumably with the NAPs (Kramer 2007).

10 11 12 **14.5.2. National Adaptation Programmes of Action (NAPAs)**

13
14 The NAPAs were born out of the seventh Conference of the Parties to the UNFCCC (COP 7), held in Marrakech in
15 2001. COP 7 saw the establishment of specific funds for assisting the Least Developed Countries in managing the
16 impacts of climate change (the LDC Fund), and the first step of this assistance was the funding of National
17 Adaptation Programmes of Action. Guidance for NAPA preparation was developed by the Least Developed
18 Countries Expert Group (LEG).

19
20 The LEG defines the purpose of NAPAs as a vehicle for LDCs to communicate their most “urgent and immediate
21 adaptation needs” to the UNFCCC for funding from the LDC Fund. “Urgent and immediate needs” are defined as
22 those for which further delay in implementation would increase vulnerability or increase adaptation costs at a later
23 stage (Least Developed Countries Expert Group, 2009). Guidelines for NAPA project preparation prepared by the
24 LEG recommend four key steps for NAPA preparation. These include:

- 25 1. The synthesis of available information on the adverse effects of climate change and coping strategies, which
26 needs to be collated and reviewed;
- 27 2. A participatory assessment of vulnerability to current climate variability and extreme events and of areas
28 where risks would increase due to climate change;
- 29 3. The identification of key adaptation measures;
- 30 4. The identification of prioritization criteria for selecting NAPA activities for inclusion in the NAPA document
31 and for submission to the LDC Fund.

32
33 Based on these steps, each country produces a NAPA document that lays out this list of priority project activities,
34 which then need to then be developed into full project documents, and can then be submitted for funding under the
35 LDC Fund, or to other funding sources.

36
37 To date, 47 countries have submitted their NAPAs (see
38 http://unfccc.int/cooperation_support/least_developed_countries_portal/submitted_napas/items/4585.php).

39 40 41 *Key Lessons from NAPAs*

42
43 NAPAs constitute a body of early adaptation planning and reflect a growing recognition under the UNFCCC of the
44 links between climate change and development processes; the need for context-specific and country-driven planning
45 processes for adaptation; and the need for multi-stakeholder approaches to both planning and implementation. For
46 example, the annotated NAPA guidelines explicitly recognise the underlying factors related to development that
47 exacerbate vulnerability, and the need to address these to build resilience to climate change ((Least Developed
48 Countries Expert Group, 2009). NAPAs are based on several key principles: Preparation should be ‘country driven’;
49 NAPAs should be developed through participatory processes involving a variety of stakeholders across relevant
50 government, civil society and private sectors; prominence given to community-level input as an important source of
51 information; and they should be complementary to and build on existing development and environmental plans and
52 programmes ((Least Developed Countries Expert Group, 2009).

1 Yet, the few critical reviews of country experiences in developing NAPAs suggest that much can be learned for
2 improving adaptation planning under other processes such as the National Adaptation Plans (NAPs) currently under
3 discussion. These include:

4
5 First, the need to focus on medium and long term programmes and processes, rather than short term 'projects'.
6 Schipper (2007) suggests that in taking a projectised approach to adaptation contradicts the need to see adaptation as
7 a process of building adaptive capacity by creating the enabling conditions for adaptation to take place. Indeed, the
8 notion of meeting 'urgent and immediate' needs reveals that adaptation is something that can be done in the short
9 term, and not part of a longer term planning process.

10
11 Second, the need to provide adequate guidance on the engagement of multiple stakeholders (Kaur and Ayers, 2010).
12 For example, the LDCF guidelines for NAPA preparation state that multi-stakeholder participation and the
13 incorporation of local knowledge should be key elements of the NAPA preparation process (LEG 2002). However,
14 critics observe that this guidance was lacking on the mechanisms of participation, and as such many NAPAs adopted
15 a cursory 'consultation rather than participation' approach (Ayers, 2011; COWI/IIED 2009); and participation has
16 been limited to identification of adaptation needs only, and not carried forward to implementation. Furthermore, the
17 projects tend to overlook the role of rural institutions, whether in terms of consultation or coordination (Agrawal and
18 Perrin, 2008).

19
20 Third, the critical role that supporting NAPAs can play in building country-capacity for adaptation planning (Ayers,
21 2008; Osman-Elasha and Downing, 2007). However, the extent to which capacity is built depends on the approach
22 taken to stakeholder engagement, and the level of ownership taken in planning at the national (COWI/IIED, 2009)
23 and sub-national (Agrawal and Perrin, 2008) level. Agrawal and Perrin suggest that NAPAs tend to build the
24 capacity of national governments and agencies rather than local actors and local institutions (Agrawal and Perrin,
25 2008).

26
27 Fourth, the need for adequate implementation strategies accompanying NAPAs. Only around 30% of the NAPAs
28 dedicate a specific paragraph on an implementation strategy or framework⁴, while a little more than 20% of them
29 have general implementation arrangements detailed⁵. From this, several observations can be drawn: the fact that the
30 long-term role and impact of NAPAs are often not clearly defined, that the execution of the projects tend to be still
31 very centralized and state-based and that the roles and responsibilities of non-state actors, notably NGOs, tend to be
32 unclear. Some problems were identified (notably regarding actor's technical capacity and funding), which did not
33 prevent some countries to devise elaborate and innovative strategies.

34
35 [FOOTNOTE 4: These countries are Bhutan, Comoros, Djibouti, Lesotho, Malawi, Maldives, Nepal, Samoa, Sao
36 Tome E Principe, Senegal, Solomon Islands, Tanzania, and Uganda.]

37
38 [FOOTNOTE 5: These countries are Burundi, Cape Verde, Gambia, Guinea, Haiti, Kiribati, Lao PDR, Mali,
39 Mauritania, and Tuvalu.]

40
41 _____ START BOX 14-1 HERE _____

42 43 **Box 14-1. The Case of Nepal**

44
45 Among the NAPAs, Nepal stands out as with a very elaborate implementation strategy that is part of a broader
46 framework. As Ciplest *et al.* explains, it 'has gone far beyond the basic NAPA criteria to build institutional capacity
47 for long-term adaptation planning and action' (Ciplest *et al.*, in press: 2). The Government of Nepal developed an
48 "expanded NAPA" that 'acts as a catalyst for building broader institutional capacity, knowledge, and leveraging
49 investment around long term adaptation planning' (Ciplest *et al.*, in press: 3). The NAPA is seen as 'the basis for all
50 support to adaptation activities in Nepal in order to ensure a coherent programmatic approach and systematic
51 reduction of vulnerability and climate change impacts nationwide.' (Nepal: 22). This implies the setting up of a
52 'common coordination, management and monitoring mechanism' for the implementation of all adaptation projects
53 to come. It is also noted that '(the) framework will facilitate the channeling of financial resources and technical
54 expertise for adaptation to the local level as efficiently as possible'.

1
2 Concretely, the proposed framework, ensuring the long-lasting impact of the NAPA and the future use of the
3 information and lessons it allowed to gather, is structured as follows:

- 4 • Preparation and dissemination of a NAPA document (...);
- 5 • Development and maintenance of a Climate Change Knowledge Management and Learning Platform for
6 Nepal
- 7 • Development of a Multi-stakeholder Framework of Action for Climate Change in Nepal. (Nepal: 6).

8
9 The NAPA process in Nepal also led to the preparation of the LAPA (Local Adaptation Plan of
10 Action) framework and LAPA manual, which aims to integrate adaptation options in the local planning process. The
11 LAPA process provides opportunities to further assess site-specific climate vulnerabilities, identify adaptation
12 options, and implement adaptation actions with people's participation (GON, 2011a). The LAPAs have been adopted
13 as a National Framework, which specifies over 80 percent of the total budget of the climate change programmes will
14 be channeled to the local level, for processes driven by local ownership and leadership (GON, 2011b).

15 _____ END BOX 14-1 HERE _____
16

17
18 Finally, the need to follow-up planning with adequate funding for implementation. So far, NAPA projects have not
19 been substantially financed, which, according to LDC delegates, adds to the hindrances posed by the access
20 procedures to LDCF funding and by slow funding (Ciplet *et al.*, in press). Ciplet *et al.* observe that, as of May 2011,
21 the GEF Chief Executive Officer endorsed or approved only 28 NAPA projects to be funded. One result of this
22 financial issue seems to have been the accumulation of delays and the outdatedness today of many of the needs first
23 assessed in the NAPAs (Ciplet *et al.*, in press).

24 25 26 **14.6. Measuring Adaptation**

27
28 Work on adaptation has tended to lag behind mitigation efforts in both in research and in the climate negotiations
29 (Burton *et al.*, 2002; Arnell, 2009). A partial reason is that adaptation and development specialists, governments,
30 NGOs and international agencies have found it difficult to clearly define and identify precisely what constitutes
31 adaptation and what distinguishes it from effective development [14.2.1]. Also adaptation has no common reference
32 metrics, as does mitigation; namely tonnes of GHG, or radiative forcing values.

33 34 35 **14.6.1. Understanding Measurement**

36
37 The search for metrics for adaptation will remain contentious with multiple alternatives competing for attention.
38 This is inevitable as there are multiple purposes and viewpoints in approaching the measurement of adaptation.
39 Institutions, communities and individuals value things differently and many of those values cannot be captured in a
40 comparable way by metrics (Adger and Barnett, 2009).

41
42 At least three types of measurements are relevant to adaptation each requiring different characteristics of its metrics.
43 The first are metrics to help determine the need for adaptation. These metrics usually focus on measuring
44 vulnerability, but that term is not well defined as is discussed below. Further, even within this application often the
45 goal is not to produce a score or rating for application but to elucidate information on the nature of vulnerability and
46 to better identify adaptation options (Smit and Wandel, 2006). The second set of metrics relates to measuring the
47 process of implementing adaptive actions such as spending on coastal protection, the installation of early warning
48 plans, or the number of agricultural specialist with appropriate training in climate risks. Here the selection of
49 appropriate metrics is usually less contentious but although there is disagreement as to how much they represent
50 adaptation versus normal development. The third set relates to measuring the effectiveness of adaptation. This set is
51 essential to help measure progress and provide feedback on the effectiveness of actions, but are among the most
52 difficult to identify as adaption outcomes take time to become identifiable.

1 This section elaborates further on the selection of metrics for the first of the above goals; i.e. for determining the
2 basis of vulnerability (or resilience) and the need to adapt. Section 15.2.2xx deals further with measuring the
3 effectiveness of implementation and section 16.x.xx on the monitoring the effectiveness of adaptation activities.
4

6 **14.6.2. What Needs to be Measured?**

7

8 The measurement of vulnerability is central to many adaptation metrics and initially it was approached from an
9 impacts point of view. Here vulnerability is usually defined as a function of (i) exposure to specific hazards or
10 stressors, (ii) sensitivity to their impacts and (iii) the target population's capacity to adapt (IPCC 2001, Chapter 17).
11 This approach continues to be used as the basis of many assessments and adaptation prioritization efforts. Recently
12 the emphasis has moved from better defining exposure and potential impacts to a better understanding of the factors
13 that affect societies' sensitivity to those impacts and their capacity to adapt. This reflects the increasing recognition
14 of the importance of considering social vulnerability alongside biophysical vulnerability. Various terms have been
15 used to describe these different emphases including biophysical versus social vulnerability, outcome versus
16 contextual vulnerability (Sections 14.2.1.1.1 and 14.2.1.1.2; Eakin and Luers, 2006; Füssel and Klein, 2006; Eriksen
17 and Kelly, 2007; Füssel, 2007; Füssel, 2010) and scientific framing versus a human-security framing of vulnerability
18 (O'Brien, 2006). O'Brien *et al.* (2007) argue that scientific and human-security frameworks affect the way we
19 approach adaptation, with the scientific framework leading to building local and sectoral capacity to make changes
20 rather than address the fundamental causes of vulnerability, or climate change itself, within their broader
21 geopolitical and economic contexts.
22

23 Other questions also arise even within a given conceptual framework for considering vulnerability. A system of
24 measurement is usually developed to allow comparisons between different places, social groups or sectors of
25 activity. But experience repeatedly cautions us to be conservative in applying common questions and metrics of
26 vulnerability across diverse places, groups or sectors (Schröter *et al.*, 2005). Also, a system's vulnerability is not
27 static but responds to changes in economic, social, political and institutional conditions over time (Smit and Wandel
28 2006; Smit and Pilifosova, 2003).
29

30 It has also been suggested that a framework based on the concept of resilience is more appropriate than a
31 vulnerability framework in many contexts. For example, in a development context resilience "evokes positive and
32 broad development goals (e.g., education, livelihood improvements, food security), includes multiple scales
33 (temporal and spatial) and objectives, better captures the complex interactions between human societies and their
34 environments, and emphasizes learning and feedbacks" (Moss *et al.*, to appear). A resilience approach leads to more
35 focus on interactions between social and biophysical systems (Nelson *et al.*, 2007). However, the concept of
36 resilience has proven very difficult to apply in practice and is particularly resistant to attempts to establish
37 commonly accepted sets of indicators. Some (e.g. Klein *et al.*, 2003) have suggested that it has become an umbrella
38 concept that has not been able to support effectively planning or management.
39

40 But vulnerability is not adaptation. Smit *et al.* (2001), Osman-Elasha *et al.* (2008) and others have suggested that our
41 focus should be on increasing adaptive capacity within the context of the full range of biophysical and socio-
42 economic stressors. But metrics designed to capture these aspects are often less suitable for distinguishing
43 'adaptation' from 'sustainable development' (McGray *et al.*, 2007) and thus may be less suitable for other purposes
44 such as helping to identify "the full and additional costs of adaptation".
45

46 Vulnerability indices have usually been designed to better understand the drivers of vulnerability or to compare
47 countries, regions, communities etc. in terms of the risks they face from climate change and their capacity to deal
48 with them. This is not necessarily the same as designing an allocation index or rule to be used to allocate limited
49 resources equitably and efficiently among entities (countries, regions or other administrative groups, or different
50 proponents of adaptation). For allocation we might expect that vulnerability and coping/adaptive capacity would
51 remain a core consideration, but so also should the ability of the recipients to absorb the funding and implement
52 policies and projects to actually achieve the projected benefits (UNFCCC, 2007; Wheeler, 2011).
53

1 In deriving indices of vulnerability there are again two broadly different approaches. One is to deductively identify
2 indicators that theoretically should be strongly related to vulnerability, while the other is inductive and uses
3 observed data to seek correlations between indicators and observed consequences of vulnerability, such as the
4 number of people killed or affected by climate related events in recent history. There is some commonality in
5 identifying the desirable criteria for selecting indicators, which have been concisely summarized by Perch-Nielsen
6 (2010) in Table 14-1.

7
8 [INSERT TABLE 14-1 HERE

9 Table 14-1: Set of criteria for selection of indicators (Perch-Nielsen, 2010).]
10
11

12 **14.6.3. Established Metrics**

14 *14.6.3.1. Vulnerability Metrics*

15
16 Numerous metrics continue to be prepared for a variety of purposes and at scales ranging from comparing the
17 vulnerability of communities to countries. Several reviews including Moss (2001, to appear), Srinivarsan and
18 Prabhakar (2008), Anderson *et al.* (to appear) that discuss both the design and effectiveness of many of the existing
19 proposals for adaptation metrics.
20

21 Eriksen and Kelly (2007) compared five measures for comparing national vulnerability published over the period
22 1995 to 2003. (Namely the Vulnerability-resilience indicators of Moss *et al.*, 2001; the Environmental Sustainability
23 Index of the World Economic Forum, 2002; the Dimensions of vulnerability of Downing *et al.*, 1995; the Index of
24 Human Insecurity (IHI) of Lonergan *et al.* 1999; and the Country-level risk measures, Brooks and Adger 2003.)
25 Between them, 29 indicators were used with only five indicators appearing in more than one study. They were able
26 to compare the top 20 ranked countries derived from three of the studies and found little overlap with only five
27 countries ranked in the top 20 in more than one study. However, it must be noted that the indices were developed at
28 different times and for different purposes. They concluded that the indices focused on measuring a snapshot of
29 aggregate conditions nations rather than delivering guidance on societal processes that can be targeted to reduce
30 vulnerability.
31

32 There are a series of disaster related indices designed to assess relative risks across countries and regions, and to
33 provide benchmarks on which to assess progress (UNDP Disaster Risk Index, 2004; Hotspots Index of Dilley *et al.*,
34 2005; the Americas Index of Cardona, 2005; and an index for South Asia of Moench *et al.*, 2009). Again there has
35 been little effort to further analyse, validate or compare these indices.
36
37

38 *14.6.3.2. Metrics and Resource Allocation*

39
40 Metrics for adaptation do come into play in major decision making processes about the allocation of funding. One of
41 the longest running and prominent use of metrics in funding is the World Bank's process of allocating IDA
42 concessional funds to developing countries which faces many issues analogous to the same process for adaptation.
43 The World Bank uses the Country Policy and Institutional Assessment (CPIA) based on 16 criteria to estimate the
44 extent to which a country's policy and institutional framework supports sustainable growth and poverty reduction,
45 and consequently the effective use of development assistance. These criteria are the main components used to
46 calculate a Country Performance Rating, which in turn is a major component, along with population and recent
47 performance measures, in calculating allocations to the poorest developing countries with long-term, no interest
48 (IDA) loans. The CPIA and the ultimate IDA allocation formulae are controversial, much debated (Alexander 2010),
49 often fine-tuned (IEG, 2009) but still commonly used as a reference point for this type of procedure (GTZ, 2008).
50

51 An explicit example of the use, and non-use, of adaptation metrics was in establishment of the Pilot Program for
52 Climate Resilience (PPCR). The governing body (made up of contributors, recipients and other stakeholders) set up
53 an expert group to make recommendations as to which countries might be included as pilots within the c.
54 USD1billion program Climate Investment Fund 2008). The expert group refrained from using a simple index, but

1 instead country selection was done across 9 regions and based on a suite of indices appropriate for the region and on
2 expert judgment. The twelve indicators were used by the expert group reflected both the outcome and contextual
3 concepts of vulnerability and the most consistently used were:

- 4 1) The Human Dimension Index
- 5 2) An index based on the proportion of the population affected by climate related disasters in the past 30 years
- 6 3) The percentage of the population undernourished
- 7 4) The percentage of the population without access to improved water
- 8 5) The percentage of the population in the low elevation coastal zone.

9
10 It is interesting to note that on moving to the next step of deciding on allocation of financial resources to the selected
11 pilot countries the governing body of the PPCR chose not to use an approach based on indicators, but to provide
12 guidance to the countries of the possible range of funding and to base allocations on the quality of the proposals
13 bought forward (CIF 2009). None of the other governing bodies of international funding mechanisms (e.g. the GEF,
14 the Adaptation Fund) has chosen to use a defined set of metrics within their decision making.

15
16 Wheeler (2011) has developed an index of vulnerability based on weather related disasters, sea-level rise and
17 agricultural productivity. The index can be adjusted according to user preferences to develop allocation formulas
18 based only on biophysical vulnerability, further adjusted for economic development and governance, and finally for
19 project costs and probability of success. Klein and Möhner (2011) have discussed the options for the Green Climate
20 Fund based on experience to date and conclude that that science cannot be relied upon for a single objective ranking
21 of vulnerability.

22 23 24 *14.6.3.3. Metrics for Monitoring and Evaluation*

25
26 The IPCC's *Fourth Assessment Report* provided little discussion of the role of evaluation and monitoring of
27 adaptation responses as a component of building adaptive capacity (Adger *et al.*, 2007). Preston *et al.* (2011)
28 identify three specific roles of evaluation: a) ensuring reduction in societal and ecological vulnerability; b)
29 facilitating learning and adaptive management; and c) providing accountability for adaptation investments (see also
30 GIZ 2011). A central challenge in developing robust monitoring and evaluation frameworks for adaptation is the
31 existence of multiple valid points-of-view that can be used to evaluate adaptation (Gagnon-Lebrun and Agrawala,
32 2006; Perkins *et al.*, 2007; Füssel, 2008; Smith *et al.*, 2009; Ford *et al.*, 2011; Preston *et al.*, 2011). This challenges
33 the selection of appropriate metrics for the monitoring and evaluation of adaptation and its contribution to
34 vulnerability reduction (Burton and May, 2004; Gagnon-Lebrun and Agrawala, 2007; Hedger *et al.*, 2008; IGES,
35 2008; Ford *et al.*, 2011).

36
37 One of the central unresolved tensions in progressing evaluation is the relative merit of targeting adaptation
38 processes versus outcomes. Preston *et al.* (2011) suggest the evaluation of adaptation processes may be a more
39 robust approach to evaluation, due to the challenges in attributing future outcomes to adaptation strategies and the
40 long-time lags that may be needed to assess the performance of a particular strategy (Berkhout, 2005; Dovers and
41 Hezri, 2010; Ford *et al.*, 2011). Much of the adaptation evaluation literature focuses on the evaluation of adaptation
42 planning and/or programs rather than specific adaptation actions for a given sector or region and much of the
43 adaptation activity represents capacity building rather than the reduction of vulnerabilities (Preston *et al.*, 2011).

44
45 The OECD analyzed the monitoring and evaluation processes across 106 projects across six development agencies
46 and found that Results Based management and Logical Framework approached dominated as they do in normal
47 development projects (Lamhauge *et al.*, 2011). They drew attention to the need for appropriate baselines and
48 complimentary sets of indicators that track not just process and implementation, but also the extent to which targeted
49 changes are occurring. Monitoring programs themselves need careful design to ensure that they remain in place over
50 the long timeframes needed for the outcomes to be identified; that they contain incentives for beneficiaries to
51 comply with conditions and that compliance itself does not impose undue burdens.

52
53 A number of national and international organizations have guides to monitoring and evaluating adaptation activities
54 (McKenzie Hedger *et al.*, 2008; UNDP, 2008; WRI, 2009; World Bank, 2010; GIZ, 2011). These guides tend to

1 focus on the wider framework of identifying and managing adaptation related activities and within that the criteria
2 for the selection of metrics for monitoring and evaluating those activities. These issues are dealt with in Chapters 15
3 and 16.

6 **14.6.4. Validation of Metrics**

7
8 The practice of developing and applying metrics in adaptation has been subject much scrutiny. Eakin and Luers
9 (2006) express serious concerns about national-scale vulnerability assessments ranging from the quality of the
10 available data, the selection and creation of indicators, the assumptions used in weighting of variables and the
11 mathematics of aggregation. Downing (to appear) has made a similar critique. Nevertheless indices will continue to
12 be used and the challenge is to identify and maintain basic standards of best practice.

13
14 One of the most comprehensive attempts to validate a system for measuring important components of adaptation is
15 that of Brooks, Adger and Kelly, 2004. They used the probability of climate related mortality from the CRED data-
16 base as a proxy for risk and a set of 46 social, governance, economic and biophysical measures as indicators of
17 essentially social vulnerability. They then used an inductive approach to identifying indicators by analyzing the
18 number of people killed in climate related disasters over recent decades in relation to a wide range of potential
19 indicator variables. They found 11 that were selected as effective indicators and these were confirmed as useful by a
20 small focus group (7 people) of adaptation experts. These experts also ranked the variables in terms of their
21 perception of their usefulness leading to a total of 12 different rankings to which was added a equal ranked set to
22 give 13 measures of vulnerability. Countries were then scored against these 13 rankings and the number of times a
23 country appeared in the top quintile of countries in a particular ranking was used as an indicator of its overall
24 vulnerability.

25
26 Perch-Nielsen (2010) developed an index to estimate the vulnerability of beach tourism using a systematic approach
27 by establishing a framework to identify the types of measures needed and a systematic approach to identify
28 measures that covered the range of countries and time scales. The derivation of the index from the separate measures
29 was also subjected to robustness (sensitivity) testing to determine the most appropriate methods of scaling and
30 combining the measures.

33 **14.6.5. Assessment of Existing and Proposed Metrics for Adaptation**

34
35 Srinivarsan and Prabhakar (2008) conducted a wide-ranging stakeholder survey to assess the attitudes to and
36 requirements of indicators for adaptation. Stakeholders agreed that no single metric can capture the multiple
37 dimensions of adaptation and that refinements of methodologies (e.g. rationale for index selection, aggregation
38 methods, data checking) are badly needed. But metrics for adaptation remain a necessity. Their derivation
39 challenges the adaptation community to clarify its goals, conceptual models, definitions and applications. But as
40 both theory and practice has shown indicators alone are not sufficient to guide decisions on which adaptation actions
41 to take, on how to modify sustainable development activities, or on resource allocation.

42
43 Downing (2003) noted that the climate change community was far from adopting common standards, paradigms or
44 analytic language. This still appears to be true, making the search for commonly accepted metrics, even within well-
45 specified contexts, a challenging task.

48 **14.7. Addressing Maladaptation**

50 **14.7.1. Defining Maladaptation**

51
52 Development interventions usually contribute to reducing vulnerability and improving the overall adaptive capacity
53 of the targeted sector or communities to potential climate change impacts. However, in some cases, the development
54 approach followed may unintentionally result in increased vulnerability. For example, better engineering of roads to

1 withstand current and even future climate extremes may foster new settlement into areas highly exposed to the
2 impacts of future climates. This is usually described as maladaptation, which was defined by the IPCC AR3 (2001)
3 as "any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli; an
4 adaptation that does not succeed in reducing vulnerability but increases it instead". The IPCC further states that
5 maladaptation results from decisions that prevent or constrain the ability of others to manage, reduce or otherwise
6 adapt to the effects of climate change (IPCC, 2001). In AR4 the term maladaptation was not defined, although it was
7 used occasionally. OECD (2009) in providing policy guidance on mainstreaming adaptation in development
8 programs used a similar definition to IPCC AR3 but with more emphasis on "business-as-usual development which,
9 by overlooking climate change impacts, inadvertently increases exposure and/or vulnerability to climate change."
10

11 Five dimensions of maladaptation were identified by Barnett and O'Neill (2010) including: actions that increase
12 emissions of greenhouse gases such as the use of air conditions to ameliorate the high temperature resulting from
13 climate change; actions that disproportionately burden the most vulnerable; actions that have high opportunity costs;
14 actions that reduce incentives and capacity to adapt; and setting paths that limit future choices.
15

16 17 *14.7.2. Causes of Maladaptation* 18

19 Maladaptive actions and processes often include planned development policies and measures that deliver short-term
20 gains or economic benefits but lead to exacerbated vulnerability in the medium to long-term. Similarly, the
21 construction of 'hard' infrastructure may reduce flexibility and the range of future adaptation options (OECD, 2009).
22 Also, failure to account for multiple interactions and feedbacks between systems and sectors may provide
23 inadequate or inaccurate information for developing adaptive responses and lead to maladaptive strategies (Scheraga
24 *et al.* 2003). An assessment of the downstream impacts of upstream rainwater harvesting in a semi-arid basin in
25 Southern India showed that the net benefits were insufficient to pay back investment costs (Bouma *et al.*, 2011). It is
26 important to identify all the potential socio-economic and environmental impacts that could represent maladaptation
27 by assessing potential risks and incorporating adaptation strategies in development planning (Satterthwaite *et al.*,
28 2009).
29

30 Projects that are intended to reduce poverty may not contribute to reducing vulnerability (Adger *et al.*, 2003; Eriksen
31 and Kelly, 2007; Klein, 2010a). For example, the conversion of coastal mangroves into shrimp farms may increase
32 economic productivity, but this also leads to increased vulnerability to flooding and storm surges (Klein, 2010a). In
33 other situations, adaptation efforts aimed at armoring the coastline may result in coastal erosion elsewhere while
34 building levees along a flood-prone area might encourage unwanted development within that area (National
35 Research Council, 2010). Other examples of potential maladaptive actions include continued development of highly
36 vulnerable coastal areas (Repetto 2009) and agricultural policies that promote the growing of a high yielding crop
37 varieties through subsidies with the objective of boosting production and increasing revenues, may reduce agro-
38 biodiversity and increase exposure and vulnerability of mono-crops to climate variability and change and finally
39 undermining the adaptive capacity of farmers.
40

41 42 *14.7.2.1. Experiences with Maladaptation* 43

44 Maladaptation is a cause of increasing concern to adaptation planners, where intervention on one sector could
45 increase vulnerability of another sector or group. A situation experienced by subsistence and smallholder
46 agriculturalists in Palca, Bolivia who implemented a package of strategies, often centred on intensification of labour
47 and inputs, to sustain their livelihoods in response to a multiple set of stressors, but faced by a number of potential
48 negative feedbacks arising from these interventions rendering them vulnerable to the risk of insufficient adaptation
49 and maladaptation, (Heltberg *et al.*, 2009b). Another example of maladaptive adaptation actions is the development
50 of the Wonthaggi desalination plant to improve water supply to Melbourne City in Australia. The plant will
51 damage thirteen sites significant to the Bunurong Aboriginal community and it will also lead to higher water costs
52 that will disproportionately affect the poorer households (Lee and Chung, 2007).
53

1 Some studies warn against the simplistic use of maladaptation to communicate the state of high exposure to risks
2 resulting from certain type of livelihoods. For example, the periodic movement of the nomadic pastoralists following
3 the grass and water is described by some as maladaptive, while a more focused studies on these responses indicated
4 that they are appropriate and well adapted to the local circumstances, Agrawal and Perrin (2008).
5
6

7 *14.7.2.2. Relationship between the Adaptation Deficit and Maladaptation*

8

9 Adaptation deficit is a related but different concept from maladaptation. It is defined as the inadequate adaptation to
10 the current climate conditions (Section 14.xxxx; Parry, 2009; Burton *et al.*, 2002; Burton, 2004). The deficit may
11 arise from past inaction, the mismanagement and depletion of natural resources, or maladaptive decision in the past.
12 The adaptation deficit may also result from a low level of development and the consequential reduced capacity to
13 cope with climate variability. Thus, the adaptation deficit may be part of a larger development deficit (World Bank,
14 2010). In the process of building future adaptive capacity it is important to reduce the current adaptation deficit, in
15 addition to the need for designing effective risk management and climate change adaptation measures. (Hallegatte *et*
16 *al.*, 2011).
17
18

19 **14.7.3. Screening for Maladaptation**

20

21 *14.7.3.1. Methods for Assessing Viability of Adaptation Measures*

22

23 Adaptation to climate change is increasingly been considered in the development agenda as it became evident that it
24 is not possible to make development or investment decisions while neglecting the potential impacts of climate
25 change. In general terms, adaptation could be approached in the context of development through (1) responding to
26 specific projected climate impact scenario and risk management plan (2) reducing general vulnerability and building
27 climate resilience. A series of interventions can be introduced along the continuum ranging from mainly adaptation
28 to mainly development activities. However, it is perceived that adaptation could be more efficient if it involves all
29 the challenges along the wider spectrum, which has an important bearing on financing adaptation and focusing
30 mainly on adaptation rather than development initiatives, (McGray *et al.*, 2007). To avoid a state of maladaptation,
31 screening of development interventions and adaptation measures is considered as an essential step in order to make
32 sure that they are not going to negatively impact or increase the vulnerability of other systems, sectors or social
33 groups. (Barnett and O'Neill 2010: 211). According to Parry *et al.* 2007, it is possible to decide if an adaptation
34 intervention has been successful by measuring the extent to which it exploits beneficial opportunities.
35
36

37 *14.7.3.2. Methods for Preventing Maladaptation*

38

39 Maladaptation is not necessarily associated with climate change as it can take place even under normal conditions
40 due to inappropriate decision. An example is the expansion of infrastructural development in low coastal zones,
41 which are frequently subjected to floods and storms. Avoiding these practices would be the first step in addressing
42 maladaptation. The next step would be, to plan and design adaptation strategies, for implementation and monitoring
43 and evaluation of their performance. To this end it is critical to make use of existing technologies to develop
44 information and awareness for adaptation in highly vulnerable zones (Basher, 2001).
45
46

47 **14.8. Research Gaps and Data Gaps**

48

49 [To be developed along with other chapters in next draft]
50
51
52

Frequently Asked Questions

FAQ 14.1: Are there different definitions of adaptation, and if so, which one is used by the IPCC AR5?

The most commonly used definitions of adaptation remain based on the IPCC AR3 definition (“adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities”), but with some important elaborations being proposed. The IPCC SREX modified the definition to deal separately with human and natural systems and included an element of purposefulness in human adaptation actions (i.e. “in order to moderate...”)⁶. In AR5 we will use the SREX definition and refer to ‘autonomous adaptation’ to explicitly cover adaptive responses triggered by factors other than perceived or anticipated climate change. Others have sought to place adaptation into a wider context of interacting non-climatic changes and more clearly to include purposeful adaptation actions that do not succeed in moderating harm. Increasing focus on the costs of adaptation and on evaluating adaptation practices has led to more attention to what constitutes *successful* adaptation. Some definitions of success emphasize reducing risks to a predetermined level while other focus on achieving predetermined levels of social and or economic well being (14.2.1).

[FOOTNOTE 6: IPCC SREX definition of adaptation: “In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate.”]

FAQ 14.2: Is there a difference between adaptation to climate change and adaptation to climate variability?

Both the IPCC AR3 and SREX definitions refer only to climate stimuli, or simply to climate, and thus include actions in response to current climate variability and climate change. Actions in response to currently climate variability may be considered to be dealing with the ‘adaptation deficit’; i.e. the failure to adapt adequately to existing climate risk. (14.7.3.1)

FAQ 14.3: Can adaptation be distinguished from normal development actions?

Adaptation and development are inextricably linked. Development that brings improvements in livelihoods, greater access to resources and more resilience to the wide variety of volatilities faced by household and communities, will usually also achieve adaptive outcomes (see ‘autonomous adaptation’ above). However, pursuing development priorities without looking ahead to a world with a changed climate could undermine development efforts either by failing to adjust to the possibility of changed climate or through actions that cut off options to deal with changed climates (maladaptation). (14.2.2.2 and 14.7.2)

FAQ 14.4: Is adaptation a facet of disaster risk management (DRM) or is it vice versa?

Neither. There is a strong overlap in the information needed, measures and policies applied, and goals of adaptation to climate change and DRM. Integration of the efforts across all levels of government and civil society will be efficient and more fruitful than their separation. But the overlap is not complete. For example, DRM deals with a wider range of hazards (e.g. earthquakes, chemical escapes etc.) while adaptation also has to take account of slow changes that are not perceived as disasters (e.g. slowly changing agricultural conditions). Any integration will be more effective if it respects and accommodates these differences. (14.2.2.3)

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Table14-1: Set of criteria for selection of indicators.

	Criterion	Explanation
Validity	Well-founded	Based on a tested theoretical framework
	Accurate	Really measuring what it should
	Non-ambiguous	Agreement on the direction of influence between the indicator and vulnerability
Use Type	Comprehensible	Relatively easy for users to understand
	Relevant	Applicable to many geographic and economic conditions
	Responsive to changes	Can be influenced by action
	High information content	No yes/no indicators, and preferably actual performance data instead of model-based data
Data	Available	Data that is publicly and easily available
	Homogenous and periodical data	Data that is collected homogeneously, making it suitable for international comparisons

From Perch-Nielsen, 2010 based on Aitkins et al., 1998; Esty et al., 2006 Kaly et al., 2003 and OECD, 2002.

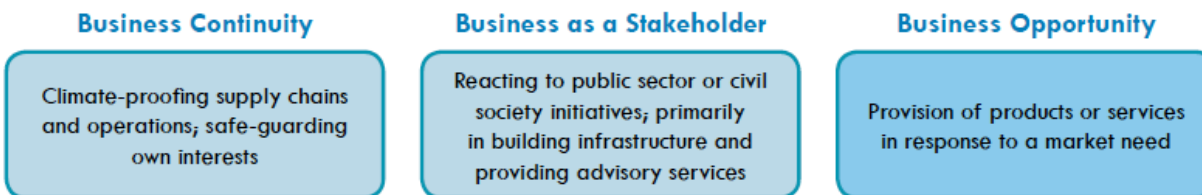


Figure 14-1: A typology of private sector engagement in adaptation (Khattari et al., 2010).