Chapter 12. Human Security

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Contents

12.7. Synthesis

Frequently Asked Questions

References

Executive Summary

Climate change is a risk to human security. Where climate change a) undermines values of importance to culture and identity, b) increases migration that people would rather have avoided, and c) influences violent conflict, it undermines human security (high agreement). For populations that are already socially marginalized, resource dependent, and have low incomes, human security will be progressively undermined as the climate changes [12.1.2; 12.2]. Increasing rate and magnitude of climate change increase the risk of compromised stability of some societies by mutually reinforcing negative interactions between cultural processes, migration and violent conflict.

Climate change acts upon culture in myriad ways that in turn affects the viability of communities, traditional and local knowledge, and the cultural repertoire and expressions important for resilience and for maintaining identity (High agreement medium evidence). Projected climate change impacts will lead to significant changes in environmental and societal conditions and in the natural resource base upon which many indigenous and non-indigenous peoples depend [12.3; 12.3]. This will compromise the cultural core and worldviews that people themselves value and rely on and thereby decrease human security. The magnitude of the impacts on cultural identity depends on the robustness of mechanisms for transferring knowledge between generations [12.3.1]. Culture and local and traditional knowledge are deeply rooted in history and reflect and reassert values and shape both adaptive and maladaptive responses. Local and traditional knowledge is often neglected in policy and research with negative consequences for human security and the effectiveness of adaptation responses [12.3.2]. There is strong evidence that the inclusion of culture and an understanding of the role of culture in adaptation efforts and policy will increase human security [12.3].

Indigenous and traditional knowledge is a major resource for dealing with the risks of climate change and for ensuring human security, but may be constrained if the changes are extreme [12.3.2] (high agreement – medium to robust evidence). Indigenous peoples have through history adapted to highly variable environmental and societal conditions, but less so to more recent globalization. The rate of change in climate in these regions will increasingly constrain the efficacy of indigenous and traditional knowledge in informing adaptive responses [12.3.2]. Currently many indigenous peoples are politically and economically marginalized and live in regions or depend on natural resources that are highly sensitive to climate change. Indigenous peoples are often able to productively combine traditional and modern values and practices, they are at risk when their voices are ignored and when policies and institutions impede and constrain their livelihoods and lifestyles [12.3.3]. Maintaining the human security of Indigenous peoples under climate change will require their full inclusion in assessments, decision-making, policy development, and policies that facilitate intergenerational transfer of knowledge and training [12.3].

Impacts of climate change and extreme events increase the potential for displacement of populations, with increasing risks with higher levels of temperature and sea level rise (high agreement, robust evidence). In all scenarios of future climate change, displacement migration is high in areas with loss of agricultural productivity and with coastal inundation. The majority of displacement associated with climate change impacts is internal, but international migration is important in small countries and for well-established historical migration flows [12.4]. Specific migration flows are sensitive to changes in ecosystem services and hence current rural to urban migration flows in the developing world may be amplified by climate change impacts. Present migration flows and trends point to increases in the populations exposed to climate change impacts in destination areas, particularly in urban centres in developing countries.

Migration is a major adaptation strategy to enhance human security to climate change impacts (high agreement, medium evidence). There is significant evidence that migration and mobility are a significant adaptation strategy in all regions of the world in the face of climate variability. There is also robust evidence that

resource scarcity reduces the mobility of specific vulnerable social groups. Lack of mobility by vulnerable populations will result in higher exposure to weather-related extremes in both rural and urban areas in the developing world. The complexity of motivations for individual migration decisions rules out categorization of groups or individuals as climate-related migrants.

There is evidence that climate change impacts could elevate risk of violent political conflict indirectly through diminishing human well-being as a cause of localized or wider conflicts within countries (high confidence). Droughts, elevated temperatures, and ENSO teleconnections are statistically associated with elevated risk of internal war outbreak in poor countries, though the mechanisms are not known with certainty. Conflict risk is shaped by many factors, only some of which are directly affected by climate; therefore climate stress will not trigger conflicts uniformly but instead be relevant primarily where other risk factors are already high [12.5].

People living in countries and regions in violent conflict are more likely to be vulnerable to climate change than people living in countries that are free from such violence (high confidence). Violent conflict and disrupted ability of states to provide human security are widespread problems: in such countries much of the infrastructure and institutions that help people to adapt to climate change are impaired 912.5.2]. Among other factors, low levels of public spending, low levels of social cohesion, damaged infrastructure, disruptions in livelihoods and settlement patterns, and disruption of markets work to reduce the ability of people to adapt to climate change

Climate change will lead to new threats to state security and by extension will significantly shape both conditions of security and security policies of nations (high confidence). Physical aspects of climate change, such as sea level rise, hydrologic disruptions, and loss of sea ice, have already contributed to significant reevaluation of national security threat assessments [12.5.3]. Some states are experiencing threats to their territorial integrity, including small island states and other states at high vulnerability to sea level rise [12.5.4]. Others are experiencing major threats to vital infrastructure, such as water and power. Projected climate change impacts will expand the security dimensions and risks for nations. Disruptions in geopolitical navigation routes and resources, for example in the Arctic, will lead to new regional competition over resources and changes in economic geography of trade and settlement.

12.1. Concepts and Evidence

12.1.1. Human Security in the IPCC Assessment Reports

This chapter assesses what is known about the risks climate change poses to individuals and communities, including risks to livelihoods, culture, and demographic and political stability. These risks were raised throughout the report from Working Group II (WGII) in the Fourth Assessment Report (AR4), but not examined collectively, or in any detail. The report identified the risk climate change poses to livelihoods (chapters 5, 7, 9 10, 16, and 17), and cultures and Indigenous peoples, particularly in the Arctic. There was frequent reference to culture, and in particular Indigenous Knowledge, as a resource to support adaptation, particularly in Africa and the Arctic.

The WGII AR4 report noted the risks climate change poses to: food security, water security, and to a lesser degree energy security and social security. There was reference to security as fundamental social goal (chapter 7), and chapter 11 noted that the risks climate change poses to national security were poorly understood. Violent conflict was recognized a driver of vulnerability to climate change. Migration was recognized as a stressor that increased vulnerability to climate change. Chapter 19 identified an exacerbation of violent conflict and increased migration pressures a key vulnerabilities arising from climate change. Chapters 7, 16 and 17 noted that migration can be an adaptation strategy and can enhance adaptive capacity.

Since the AR4 there has been new research investigating the linkages between climate change and human security. This chapter draws on that specific new research and on well-established evidence on human security and environmental risks (Matthews et al., 2010; O'Brien et al., 2012) to assess the interactions of climate change and these elements of human security: including assessments of the state of knowledge about climate change and: livelihoods, culture, Indigenous peoples, migration, and conflict. Elements of human security, such as food security,

well-being, livelihoods and regional perspectives, are examined also in chapters 11, 13 and 19, and in chapters 22-29.

12.1.2. Definition and Scope of Human Security in this Assessment

Human security is a condition that exists when the vital core of human lives is protected, and where people have the freedom and capacity to live with dignity (Barnett et al. 2010, CHS 2003, Gasper 2005). This assessment, in the context of climate change, defines the 'vital core' of human lives includes the fundamental needs and rights that people need in order to make informed choices and act on behalf of their interests (CHS 2003, see Box 12-1). Human security encompasses universal (such as healthy food), and culturally specific (such as religion), material (such as the need for clean water), and non-material (such as social recognition) elements necessary for survival, sustainable livelihoods, and dignity (CHS 2003, Hoogensen and Stuvøy 2006, Inglehart and Norris 2012, Mahoney and Pinedo 2007). Human rights are a specific means of defining limits, benchmarks and social processes that provide human security, but the human rights approach is not the dominant framing of this chapter.

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Box 12-1. The Relationship between Human Rights and Human Security in the Context of Climate Change

Human security is inclusive of human rights (CHS 2003). Human rights are both an important element of human security, as well as being instrumental to the achievement of human security.

Climate change puts human rights at risk. There is research on the ways in which observed and future climate change impacts breach existing human rights as practiced and recognized in international law (Humphreys, 2010, Slade 2007). Caney (2010), for example, suggests three human rights are at risk from climate: the right to life, the right to health, and the right to a minimum subsistence amount of material well-being. He considers the arguments for these and whether other rights are defensible, such as a right to development or a right to residence and not to be forcibly moved. Others consider rights of non-humans as part of a set related to climate change impacts (Gardiner, 2004; Nolt, 2011).

Given the risks climate change poses to human rights, there is research that examines existing and projected legal issues around the practicality of human rights in policy, litigation and compensation related to impacts and insecurity (Posner 2007). There are a number of test cases that have tested these rights, especially of indigenous peoples, in practice. A further set of research argues arguments that rights may not be useful in climate policy (e.g. Adelman, 2010; Depledge and Carlane, 2007).

Finally, it has been argued that those whose human rights have been most violated are most often those whose rights are most vulnerable to climate change, and that in places where there are extreme human rights violations, the protection of human rights is an important adaption strategy than is a pre-requisite for locally-based actions that seek to address specific climate impacts (Barnett 2009).

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Much research in human security focuses on various short-term threats to the vital core of people's lives, including economic crises, epidemics and public health, extreme events, and violent conflict (CHS 2003). There are also social and environmental threats that are more incremental in nature, for example declining access to markets, or land degradation. This chapter specifically assesses research that investigates the ways in which climate change may exacerbate many of these threats (for detailed evidence on food security see Chapter 7 and on epidemics and public health see Chapter 11). There are underlying processes that reduce the freedom and capacity of individuals and groups to adequately respond to these threats, including fear for personal safety, illness, illiteracy and innumeracy, poverty, and restricted access to economic, social and natural resources (Betancourt et al. 2010, CHS 2003, Goldsworthy 2010, Hoogensen and Stuvøy 2006). This chapter assesses research that investigates the ways in which these and other factors restrict the ability to adapt to climate change. The chapter also assesses research on the

interaction between state security and human security that suggests that the increased human insecurity that arises from an inability to adapt to climate change may in turn create risks to national security through large-scale migration and an increased risk of violent conflict. It also assesses how states provide protection and human security to their citizens.

Human security is also an analytical lens that focuses attention on the ways in which cultural, demographic, economic, and political forces interact with climate change in ways that affect individuals and communities to different degrees (Betancourt et al. 2010, Hoogensen and Stuvøy 2006, Krause and Jütersonke 2005, O'Brien 2006). The focus is at the local level, but the analysis concerns drivers of change across multiple scales and sectors, including climate, culture, gender relations, markets, political institutions, and population (Goldsworthy 2010, Hoogensen and Stuvøy 2006, O'Brien 2006). There is no single body of evidence about these multi-sectoral and cross-scale climate and social processes that influence human security (see Box 12-2).

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Box 12-2. The Nature of Evidence about Climate Change and Human Security

Understanding the effects of climate change on human security requires evidence about social and environmental processes across multiple scales and sectors. This process-based evidence is not coherent and contiguous; it comes in different forms, and is collected through a wide array of methods used in a wide range of academic disciplines. For example, this chapter assesses anthropological research that has used ethnographic techniques to understand the ways in which culture shapes responses to climate change and may in turn be shaped by climate change, alongside political-economy studies using aggregated data sets to seek correlations between climatic factors and violent conflict.

Research on human security and climate change is informed by analogous evidence: theories, models and evidence on how climate variability and environmental risks affect present human security. There is well established evidence about links in the theorized chains of causality, and where there is agreement about these links among empirical studies then they can be said to be robust explanations. This is the way social science research on the human dimensions of environmental change progresses.

This chapter includes assessment of empirical studies from the social sciences, many of which have collected and analyzed qualitative data, often using case study research design. Most of these studies examine the interactions between environmental changes and social processes to explain social outcomes. Few are explicitly about climate change and human security, but all provide evidence that is analogous to the effects of climate change on human security (Ford et al. 2010). Evidence from individual case studies is well suited to explaining causality in given contexts, but not well suited to generalizable theories. However, where evidence about causality from multiple case studies is in agreement, generalization is possible.

This chapter also assesses studies that use quantitative data about large social units (such as countries). This research seeks correlations, which, if found, help to prove associations between factors. Correlations are not explanations of causality, although when positive they do help to test theories of causality. A failure to find a correlation does not, however, necessarily disprove a theory about causality.

Given the complexity of the processes that link climate change to human security; uncertainties in the research about the biophysical dimensions of climate change; and the nature of the social science evidence thus far, highly confident statements about the general effects of climate change on all aspects of human security are not possible (Scheffran et al. 2011). There is strong evidence about some aspects of the links between climate change and human security, qualified using the language of uncertainty that is applied throughout this assessment report.

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Human security is a condition that is experienced by more people in developed than developing countries, yet it is not experienced by all people in developed countries, nor is it that case that all people in developing countries are

insecure (Mahoney and Pinedo 2007, Pietsch and McAllister 2010). There is a significant body of research to suggest that while the impacts of climate change on human security will be experienced most in developing countries, human security is at risk for vulnerable populations everywhere (Ford and Ford 2010, Naess et al. 2006, Leichenko and O'Brien 2008).

Human security in the is the inverse of social vulnerability in that it implies the protection of people from severe shocks arising from changes in social or environmental conditions (CHS 2003, Fisher 2011, UNDP 2004). It also provides a goal and means for adaptation, where the goal is to enhance human security, and the means is through social and environmental policies and programs that ensure social protection and expand people's freedoms and opportunities necessary for survival, sustainable livelihoods, and dignity (Barnett 2010).

The framing of climate change as a security issue is not without its critics. Some authors suggest that discourses on climate change and national security tend to downplay differences in responsibility and vulnerability, ignore the human security dimensions of climate change, and may justify mitigation and adaptation responses that are inappropriate (Barnett 2007 and 2009, Dalby 2009, Floyd 2008, Liverman 2009, Verhoeven 2009, Tombetta 2008). Nevertheless, for some countries the risks of climate change are like those associated with conventional security risks, and many countries are concerned about the risks climate change poses to relations between states (see sections 5 and 6). This chapter adopts a broader approach to security, as human security, which is widely supported in the literature (Barnett, 2001. Matthew et al. 2010, O'Brien et al. 2010, O'Brien et al. 2012).

12.2. Economic and Livelihood Dimensions of Human Security at Risk from Climate Change

There is extensive evidence that climate change impacts directly affect the underlying components of human security. Elements of health and dimensions of poverty are considered in detail in Chapters 11 and 13, and not detailed here. This section reviews how the material aspect of human security may be affected by climate change impacts through risks to the basic needs for life and livelihood. It summarises evidence in this area and refers to the indepth results in the cognate chapters in this assessment. The evidence here points to the principal conclusion that human security will be significantly undermined by direct impacts of climate change on basic needs and the materials to sustain life and livelihood for marginalised populations everywhere.

Basic needs refer to necessities fundamental to human survival and for the performance of essential actions as citizens, workers or parents (Reader 2006). While immediate basic human needs are for food, shelter, and clothing (Kumssa and Jones 2011), the widely accepted definition of basic needs also includes sanitation, a minimum set of capital assets and mobility, and social provision such as access to education, healthcare, and community infrastructure (Reader 2006; Johnson and Krishnamurthy 2010). On the other hand, livelihoods as elaborated in Chapter 13, are usually associated to people's access to five capital assets such as social, natural, financial, human, and physical (Scoones 1998, Pretty and Hine 2000, Talossa 2008). Components of basic needs and livelihood assets have a lot in common although livelihoods may be viewed as the major vehicle to satisfy, at the minimum, the immediate human basic needs. In contrast, major extreme events like floods, droughts or storms can reduce access to basic needs, undermining the individual's capability to engage in productive livelihood activities.

Provision of human basic needs and livelihoods is the first line of defence against climate-induced disasters. A growing body of literature on climate change and human security indicates that basic needs and livelihoods, especially of the poor communities around the world, are increasingly threatened from the adverse impacts of climate variability and change together with the combined effects of non-climatic stressors (e.g. O'Brien and Leichenko 2007; UNDP 2007; O'Brien et al. 2008; Adger 2010; Kumssa and Jones 2011). Table 12-1 summarises studies on how climate variability and change affects the material aspect of human security. It categorises this evidence under two main dimensions: 1) deprivation of immediate basic needs; and 2) erosion of livelihood assets and human capabilities (Table 12-1). Much of the evidence on the impacts of climate change on basic needs relates to agriculture and food security, water stress and scarcity, and destruction of homes and properties. Both observational and projected evidences show that climate-related risks associated with droughts, floods, storms, and other events have the potential to disrupt people's lives and deprive them of their immediate basic needs including food, water and shelter.

[INSERT TABLE 12-1 HERE
Table 12-1: Observed and projected impacts of climate variability and change to basic needs and livelihoods undermining human security.]

Climate shocks such as droughts are also observed to erode livelihood assets such as natural capital like timber and livestock (Paavola 2008; Carter et al. 2007). A growing body of livelihoods literature likewise indicates that climate variability and change disrupts production, cut income, reduce spending, or alter common practices of households which affect their financial situation, nutrition and health, as well as deprived children of education opportunities, particularly in less developed countries of the world (see for instance, Leary et al. 2008; Peras et al. 2009; Tang et al. 2009). Adverse impacts of climate change particularly on health and education of children can lead in the long run to erosion of human capability (Costello et al. 2009; UNDP 2007). Similarly, evidence based on projections using various socio-economic and climate change scenarios indicate an increase in economic and health risks, including loss of lives in both less developed and developed countries which imperils human security (Hall et al. 2003; Tang et al. 2009; Kainuma et al. 2004).

It is well established from a range of disciplines that: a) those who are most vulnerable and marginalized have the least capacity or opportunity to prepare for the impacts of a changing climate; and b) that the vulnerable and marginalised will suffer the greatest impacts of climate change (e.g. Tanner and Mitchell 2008; Lambou and Piana 2006; Brody et al. 2008). Those at greater risk include individuals and households below the poverty line in all countries, whose vulnerability is exacerbated by social and physical factors. The poor face limited access to resources, entitlements, information, and decision-making processes. There is much evidence that poorer households live in places with a higher exposure to weather-related risks in both rural areas and urban centre throughout the world. Women, children, pastoralists, disabled people, the elderly, and in some places, indigenous people are the 'poorest among the poor' and most vulnerable (Polack 2008; IPCC 2007). Climate change will have an impact on the basic needs and livelihoods of these populations threatening human security.

Well-established research methods and evaluations of development interventions provide robust evidence on how livelihoods can be secured in the context of external shocks and how opportunities can be enhanced through adaptation. Much of this research comes from development economics and related disciplines (Elllis, 2000; Dercon, 2004), and is increasingly applied to studies of adaptation to currently observed and future climate risks.

Diversification of income generating activities is a key strategy for maintaining livelihoods through periods of change both in agricultural and fishing systems (Paavola 2008; Galvin 2009; Tolossa 2008; Badjeck et al. 2010; Coulthard 2008; West and Hovelsrud, 2010). When access to natural capital is significantly restricted, intensification of use of remaining accessible natural capital can also augment livelihoods. For example, faced with social and environmental changes, farmers can apply more labour and inputs to existing crops (Gray and Kevane 2001). Studies show that both intensification and diversification can simultaneously be part of the portfolio of adaptation strategies households use (Eakin 2005, Eriksen at al. 2005, Paavola 2008).

Migration, too, is an adaptive response to maintain livelihoods under conditions of change. For pastoralists and fishers, accessing new lands or waters for growing and harvesting can enable production of fish and livestock to continue despite environmental changes. Migration of workers, permanent, or seasonal or circular, is a key response of households to adapt to variable environmental conditions. It is a strategy documented by fishers in Ghana and Peru (Badjeck et al 2009; Perry and Sumaila 2007), and by pastoralists in Tanzania (Galvin 2009).

Insurance, from formal markets and from informal sources, also assists households to recover livelihoods after disasters, and there is scope for more formal insurance services to assist fishers to adapt to climate change (Badjeck et al. 2010). Clear and defined rights to access and use resources are frequently seen as being critical enablers of climate change adaptation, for example with respect to water (Slaughter and Wiener 2007). However, transferring common property resources into exclusive ownership is a barrier to adaptation, as demonstrated in studies of pastoral systems (Galvin 2009, Tolossa 2008), and adaptation to storms and sea-level rise in Vietnam (Adger 2000). Flexibility in rights to access and extract resources enables adaptation to changing environmental conditions (Galvin 2009).

Education is the key to empowering women, and in turn to reducing poverty, maternal mortality, and child malnutrition (Boyle et al. 2006, Rammohan and Johar 2009). Improving women's access to extension services, land and technology assists households to adapt to drought, and for improving household food security and poverty (Koopman 2009).

12.3. Cultural Dimensions of Human Security

12.3.1. How Culture Interacts with Climate Risks

Robust understanding of how human security is affected by the combined changes in climatic and societal conditions requires analysis of cultural underpinnings of society (Crate and Nuttall, 2009; Nuttall, 2009*)*. A study of the complex nexus of human security, culture and climate change requires a culturally relativistic perspective where each culture has its own logic that may not seem rational to someone from another culture. Climate change is embedded in, and acts upon culture in myriad ways, and because climate change has consequences for people there is high confidence that it also has significant cultural implications (see Strauss in prep; Crate, 2011), with knock-on effects for human security. This is because culture is holistic, dynamic, and encompasses and frames virtually all aspects of human life including worldviews, norms, beliefs, knowledge, values, practices, social relationships, networks, perceptions of risk, understanding and responses to the world we live in (Roncoli *et al*., 2009: 87; Strauss, 2009: 172; Crate, 2008; Heyd, 2008; King *et al*., 2008; Tingley *et al*., 2010; Crate and Nuttall, 2009; Crate, 2011; Rudiak-Gould, 2012; Sudmeier-Rieux, 2012). This bundle of cultural elements shapes resilience, adaptive and maladaptive responses (Nielsen and Reenberg, 2010; Petheram *et al*., 2010; Buikstra *et al*., 2010; Paul and Routray, 2010b; Pearce *et al*., 2009; Siurua and Swift, 2002).

There is strong evidence that for many indigenous peoples and rural communities, throughout the world, culture is constructed around livelihood activities such as pastoralism, herding, farming, small scale and artisanal fishing, rural activities, nomadism, and hunting and gathering (Devereux, 2010). Risk results from changes in climate and the environment in terms of seasonal weather variations and extreme events, drought, floods, extreme drought/flood cycles, natural hazards, sea level rise, erosion, subsidence, coral bleeching, salinization, changes in species abundance and composition, and increasingly dangerous travel conditions. In addition, and including both rural and urban settings the resilience and human security of peoples and cultures are affected by socio-economic and politically driven challenges including land-use change, power relations, changing access to food (Jacka, 2009; Lazrus, 2009; Finan, 2009; Ford *et al*., 2008; Keskitalo 2009; Onta and Resurrection, 2011) unclear tenure or property rights (Nebel, 2001; Li and Huntsinger,2011), tourism development and industrial activities such as mining (Petheram *et al*., 2010; Rees *et al*., 2008), destabilization of livelihoods, and globalization (Brown, 2009; Stadel, 2008; Keskitalo, 2008).

As illustrated in Table 12-2, flexibility and livelihood diversification are two key factors when dealing with high variability in a community resource base and are critical for successful adaptation (de Sherbinin *et al*., 2008; Desta and Coppock, 2004; Ford *et al*., 2006; Kalikoski *et al*., 2010; Hovelsrud *et al*., 2010a,b; Rybråten and Hovelsrud, 2010; McNeeley, 2011; Marshall 2011; Eakin *et al*., 2011). In drier regions, such as Africa, climate variability combined with extended cultivation, intensified agriculture, diversified economies and migration for better resources lead to depletion of resources and hence pose a risk for local farmers (Paavola, 2008). Current adaptations to recurring seemingly "normal" events may not be sufficient under more extreme conditions (Paul and Routray, 2010a). Actions to cope with impacts and transform communities are constrained by power relations and social dependencies, with much research emphasizing the heterogeneity of people within communities and communities as the nodes for risk management negotiations (Herbert, 2005; Davidson *et al*., 2003; King, 2008; Nielsen and Reenberg, 2010; Onta and Resurrection, 2011). Social, cultural or environmental constraints to adaptation may be seen an indicator of decreased human security, including breakdown of traditional institutions and networks, and rapid socio-economic and environmental change (Crona, 2006; Seixas and Berkes, 2003; Pearce *et al*., 2010).

[INSERT TABLE 12-2 HERE
Table 12-2: Cultural dimensions of human security in the context of climate change.]

12.3.2. Community and Culture at Risk

There is strong evidence that integrated community participation in risk and vulnerability assessments (e.g. Ardalan *et al.*, 2010) produces more sustainable solutions (Gero *et al.*, 2011), and that together with co-management and learning it will increase adaptive capacity (Fazey *et al.*, 2010; Armitage *et al.,* 2011). A bottom-up and participatory approach that includes both community input and awareness of culture, is necessary for reducing risks, building capacity and for capturing the multiple factors that influence human security; a macro perspective is not sufficient for uncovering the reasons for why a community does not adapt to hazards or risks (Davidson *et al.*, 2003; Harries and Penning-Rowsell, 2011; Gero *et al.*, 2011; Fazey *et al.*, 2010; Furgal and Seguin, 2006; Sudmeier-Riuex *et al.,* 2012; Anik and Khan, 2011). Understanding the local coping strategies for minimizing community risks is linked to the scale of policy (local, national, regional) and who the decision makers are (Paul and Routray, 2010a; Paul and Routray, 2010b). Policy frameworks, regulations and weak or lacking institutions may in fact create barriers for integrating vulnerability reducing approaches by community practitioners, or for actions dealing with resources use (Gero *et al.*, 2011; Burch, 2010; McNeely, 2011; Quinn *et al.*, 2011). Cooperation between the national and the local scales and also between local sectors may on the one hand reduce vulnerability, but the lack of tradition and methods for building institutional knowledge will on the other hand affect communities negatively (Glaas *et al.*, 2010). Additionally changing socio-economic and environmental conditions separate and combined may create conditions which constrain existing coping community mechanisms (Rattenbury *et al.*, 2009; West and Hovelsrud, 2010; Quinn *et al.,* 2011).

Other risk factors include the challenge of incorporating climate change in resource management (Hovelsrud *et al.,* 2010b) and the difficulty in achieving for example sustainable forest management (Ogden and Innes, 2008). In drier regions, such as Africa, climate variability combined with extended cultivation, intensified agriculture, diversified economies and migration for better resources lead to depletion of resources and hence pose a risk for local farmers (Paavola, 2008). Current community adaptations to recurring seemingly "normal" events may not be sufficient in more extreme conditions (Paul and Routray, 2010a), because such events are beyond the current cultural repertoire and understanding. Changing environmental conditions may force hunters in the Arctic to switch from one species to another which require knowledge about how to track and hunt the new species (i.e. switching from seals to walrus) (Ford *et al.,* 2006). Hunters may not have this knowledge within their culture and traditional knowledge repertoire, or local knowledge may not be sufficient to meet new conditions, such as new extreme events (Kuhlicke, 2010; Valdivia *et al.*, 2010). In the case of coastal communities in India, the conditions, both societal and environmental, have changed to the point at which local knowledge is no longer as applicable as it was in the past (Kesavan and Swaminathan, 2006). Erosion of local/traditional knowledge in the Himalayas occurs through government regulations of traditional building materials and practices. The social cohesion embedded in such practices is weakened because of a move towards concrete construction which changes the reliance on and usefulness of traditional knowledge about wood as building material (Rautela, 2005). New conditions require new knowledge to facilitate increasing the flexibility and improving livelihoods (see also Homann *et al.*, 2008).

If climate change leads to significant changes in the environment and the natural resource base upon which many cultures depend, the very cultural core and worldviews may be lost or eroded (Crate, 2008; Gregory and Trousdale, 2009). Climate change may disrupt the cosmologies, or relations between humans and spirits necessary for maintaining a balanced society (Jacka, 2009), or in the case of community relocation, for example, mythological symbols are lost (Crate, 2008), weakening the cultural fabric upon which people depend. Conversely many cultures have proven resilient and have adapted to significant changes in societal and environmental conditions throughout history and colonial encounters (Cameron, 2012; Nuttall, 2009; Strauss in prep). By adding cosmologies and cultural strategies to our understanding of the complex interplay between extreme conditions, such as drought, famine and rainfall, and production systems we have a greater chance of grappling with the human security outcome (Ifejika Speranza *et al.*, 2008; Jacka, 2009). Recognizing that systems are complex and that social and natural elements interact is critical for understanding community resilience (Aguilar *et al.*, 2009). While local level approaches are imperative, the level of community responses is also shaped by political and economic globalization (Keskitalo, 2009).

Cultural perceptions and narratives of resilience can both increase or decrease human security by way of facilitating or hindering adaptation (West and Hovelsrud, 2010; Rudiak-Gould, 2012). This is closely connected to the perception of risk in communities, where some studies suggest that perceptions of high local or individual adaptive capacity may increase vulnerability (Burningham *et al.*, 2008; West and Hovelsrud, 2010; Zamani *et al.*, 2006; Nursey-Bray *et al.*, 2012). An example from Portugal illustrates how social perceptions may in fact minimize risks, but that this understanding is often not integrated into resource management (Figueiredo *et al.*, 2009). Table 12-1 illustrates how human security is further weakened if (climate) policy does not consider the cosmologies or epistemology embedded in culture (Jacka, 2009). The perception of climate change is based on how particular English language terms are translated and understood in the local language (Rudiak-Gould, 2012), and the perception is interpreted through personal lifestories and culture (Kuruppu and Liverman, 2011). If the cosmology, religion or cognitive frames do not have the "explanatory tools" for a changing climate which requires a response, denial and paralyses may result (Rudiak-Gould, 2012; Kuruppu and Liverman, 2011). The way climate change is translated and perceived will have a bearing on how the message or understanding is incorporated into the cultural bundle which in turn will have consequences for adaptation and ultimately human security. The cultural frame for interpreting climate change may be moral, agricultural, environmental, religious and cosmological, such as in Papua New Guinea (Jacka, 2009; Rudiak-Gould, 2012; Lipset, 2011). In many cases scientifically based climate forecast or downscaling results are presented but not necessarily understood and assimilated well by for example local farmers (Roncoli, 2006). Local perceptions, which is anchored in culture, of what kind of knowledge is trustworthy may in fact question both scientific findings (Burns *et al.*, 2010; Ingram *et al.*, 2002) and how to deal with uncertain climate information (Roncoli *et al.*, 2011). Table 12-2 illustrates the cultural and environmental realms in which climate change is interpreted (Jacka, 2009) and against which human security affected.

12.3.3. Local and Traditional Knowledge

There is a strong agreement among researchers that local knowledge, involvement and engagement of local people, and an understanding of the local context or circumstances is critical for ensuring human security (Burningham *et al.*, 2008; Ellemor, 2005; Kesavan and Swaminathan, 2006; Mercer *et al.*, 2009; Pearce *et al.*, 2009; Anik and Khan, 2012). Local and traditional knowledge is a significant element of culture. It reasserts traditional values (Ford *et al.*, 2006), is often orally transferred, deeply grounded in history, experiential, dynamic, developed through interactions with other forms of knowledge and viewpoints, and highly context dependent (Hovelsrud and Winsnes 2006; Orlove *et al.,* 2010). Such knowledge provides insights into relevant aspects of climate and weather including which climate elements to forecast (extreme events, El Niño, sea ice change, precipitation, temperature, combined climate elements, icing conditions, snow), and about the local context and conditions (Gearheard *et al.*, 2010; Hovelsrud and Smit, 2010; Nyong *et al.*, 2007; Tyler *et al.*, 2007). Local knowledge and strategies about past events and historical changes to local conditions (for example range lands, sea ice or herding conditions) is valuable for understanding and adapting to current conditions and for evaluating responses to change and policy (Angassa and Oba, 2008; Desta and Coppock, 2004; Ford *et al.*, 2008; Osbahr *et al.*, 2010; Tyler *et al.*, 2007; Lefale, 2010), an important contribution in emergency management (Becker *et al.*, 2008), and important for mitigating natural disasters (Rautela, 2005). Additionally such knowledge has been utilized throughout history to adapt and mitigate climate change impacts, and add value to current development of sustainable adaptation and mitigation strategies (Nyong *et al.*, 2007). Such knowledge may be lost if it is not protected, integrated into other forms of knowledge (King and Goff, 2010; Kalanda-Joshua *et al.,* 2011), utilized in national monitoring and assessment initiatives (Kalabokidis *et al.*, 2008; Klintenberg *et al.*, 2007), in disaster risk reduction and management (Mercer *et al.*, 2009), or combined with management as in the case of fire as a forest management strategy (Bilbao *et al.*, 2010; Kalabokidis *et al.*, 2008).

Local knowledge may in this way contribute to scientific knowledge and make it more relevant for stakeholders, users, and scientists (Oberthür *et al.*, 2004; Tyler *et al.*, 2007). Although local stakeholders and scientists may identify competing opportunities and constraints when attempting to reconcile for example community growth with resilience to natural hazards (Frazier *et al.*, 2010), the interface between scientific and local, traditional and indigenous knowledge can be seen as a source of inventiveness rather than "contesting validities" (King and Goff, 2010). Across geographical regions and cultures there is strong evidence that in order to increase capacity, ensure resilience and reduce vulnerability it is necessary to transfer and integrate local and traditional and scientific

knowledge and include stakeholder perspectives (Anderson *et al*., 2007; Frazier *et al*., 2010; Marfai *et al*., 2008; Vogel *et al*., 2007; Kalanda-Joshua et al., 2011; Flint *et al*., 2011; Ravera *et a.,l* 2011). Integrating knowledge systems is highly relevant and useful for enhancing community emergency management (Becker *et al*., 2008). But efforts to integrate different knowledge systems, in terms of climate projections and local observations also reveal different results or discontinuities, which may be attributed to different perspectives, perceptions and culture (Marin, 2010; Mark *et al*., 2010). This illustrates the need for incorporating indigenous and local knowledge and observations into climatology, for creating projections and models that are locally relevant and from a trusted source (Smit et al 2010; Ifejika Speranza *et al*., 2008; Ingram *et al*., 2002), and overcoming the barriers to integrating different knowledge systems (Kwiatowski, in press; Ravera *et al.,* 2011).

In many cases local and traditional environmental knowledge is neglected or not included in for instance adaptation planning (Ifejika Speranza *et al*., 2008; King *et al*., 2007), or ignored which may increase risks (Tàbara *et al*., 2003), or not valued or pursued properly in scientific studies (Huntington: 2011). Among the Borana in Africa indigenous pastoralists' technical and organizational practices have been ignored in development interventions, which has contributed to progressive land degradation, and the erosion of social structures and poverty (Homann *et al*., 2008). In other cases, risk is reduced by incorporating local knowledge into policy and decision-making: evidence from mountain regions exposed to floods illustrates this dimension (Alcántara-Ayala, 2004), However, this raises the question of how to best incorporate local/traditional knowledge into the scientific knowledge base. The participatory approach alone may not be sufficient because of the cultural and social dynamics of power and interpretation (Roncoli *et al*., 2011). Some studies suggest that local knowledge and current experience may not be sufficient to provide the proper response to surprising or infrequent risks, hazards or events (Nunn, 2000; Burningham *et al*., 2008; Kuhlicke, 2010). Additionally if the current local and traditional knowledge is perceived locally to be less reliable because of changing environmental conditions (Ingram *et al*., 2002) vulnerability is increased (Kalanda-Joshua *et al.,* 2011) with human security decreasing. This is a particularly important aspect of the limitations of indigenous knowledge reported in many Arctic studies. Erosion of local and traditional knowledge increases the vulnerabilities and thereby decreases human security. Although some studies warn that the emphasis on the value of local knowledge may be overrated, traditional knowledge is increasingly seen as relevant on many levels; as a critical source for understanding change and for developing adaptation strategies and policies, critical input to the work of natural scientists studying the physical impacts of climate change, a source for identifying the critical socio-economic aspects and as an important bearer of culture and identity. We face many challenges in how to manage, utilize and acknowledge this form of knowledge (Huntington 2011). Similarly, the disconnect between science and policy hampers the ways a community can respond to climate change (Tribbia and Moser, 2008).

12.3.4. Indigenous Peoples

There are about 350 million indigenous peoples worldwide, legally owning 11 percent of the world's forests, and living under a wide range of social, economic and political conditions and geographic locations. Indigenous peoples represent the world's largest cultural diversity and the majority of languages, and assessments of the cultural implications of climate change and human security illustrates a strong evidence for similarities across geographical regions and climatic conditions (see Table 12-2). On the other hand, the particular political and economic context of the different indigenous peoples will have a bearing on their human security. To a great extent the livelihood and culture of indigenous peoples is closely connected to natural resources, and in many parts of the world they are economically and socially marginalized. There is a general agreement that indigenous peoples historically, through transfer of traditional knowledge, long-term observations and experience, have developed a high adaptive capacity to highly variable environmental conditions, but less so with respect to social and economic marginalization and globalization (Tyler *et al.,* 2007; Crate and Nuttall 2009). The challenges have more recently been exacerbated by climate change that poses a greater risk than before to such capacity (Crate and Nuttall 2009; Rybråten and Hovelsrud 2010). Such risks are exacerbated when traditional relocation practices no longer work (Green *et al*., 2010), when government relocate communities (Hitchcock 2009: 255) when policy creates barriers for adaptation (Wenzel, 2009), and conversely reduced if policy intervene to remove barriers for adaptation (Ford et al, 2010; Eakin et al 2011).

Lack of flexibility in where and when to relocate, access to resources, changes in the resource base, resource management encroachment and institutional constraints (Hovelsrud et al 2010b; McNeeley 2011), poverty widening disparities and lack of proper entitlements or rights for managing and using resources (Shah and Sajitha, 2009) are highly relevant aspects of human security of indigenous peoples, including communication about risks and options in native languages (Green *et al.*, 2010). Youth retention of language and knowledge, transfer of locally relevant knowledge and incorporation of cultural values in decision-making processes are critical factors (Forbes, 2007). For Arctic indigenous peoples the changing ice conditions due to climate change pose risk in terms of access to food, and dangerous travel conditions (Ford *et al.*, 2008; Ford *et al.*, 2009). Additionally there are uneven consequences related to the nature of sea ice use, local physiological setting and community socio-cultural dynamics (Ford *et al.*, 2008). This supports other studies that argue for a high level of heterogeneity in what appears to be homogenous communities or even within indigenous groups (Davidson *et al.*, 2003; Nielsen and Reenberg, 2010; Smith *et al.*, 2001).

Climate change poses particular challenges for indigenous peoples across the world, including to their traditional knowledge systems, adaptive strategies, management practices, post-colonial power relations, and cultural practices. Some studies show that current indigenous adaptation strategies may not be sufficient to meet the projected changes in future conditions, which are more extreme and beyond the current adaptive capacity (Wittrock *et al.*, 2011), or that the lack of institutional response creates barriers for action (Burch, 2010). With implications for human security indigenous peoples are often portrayed as victims of climate change (Salick and Ross 2009; Howitt *et al.,* 2011), and as highly vulnerable to the consequences of such changes on their resources, livelihoods and culture (ACIA 2005). Indigenous peoples have a right to maintain their livelihoods and their connections to homeland and place (Howitt *et al.,* 2011), and it is highly likely that the consequences of climate change are challenging this right (Crate and Nuttall 2009). Some raise the question whether the western judicial system in fact can uphold indigenous rights in the face of climate change (Williams 2012).

More recently critics have pointed out that the discussions about the impact of climate change on indigenous peoples is missing or ignoring the linkages between historical colonization and current climatic changes (Cameron 2011; Howitt et al 2012; Salick and Ross 2009). The perception of indigenous peoples as more connected to place and associated with the local than others stems from colonial history, is laden with uneven power relations, and delimit indigenous peoples to the local and traditional (Cameron 2011), whilst they are actors on the international arena. Indigenous representation and self-portrayal as victims in some arenas is itself another leftover from colonialism (Nuttall 2009). In the current post-colonial situation science is gaining legitimacy, and is increasingly utilized by indigenous peoples and vice versa (Huntington 2011). Such exchange of two forms of knowledge will strengthen the adaptive capacity of indigenous peoples.

Another salient aspect of human security is how the role and involvement of indigenous peoples and communities influence policy development and decision-making, assessments and interpretations, and training (Daly *et al.*, 2010). There is a high agreement among researchers that lack of local involvement in resource management decreases resilience and thereby human security, and that it is necessary to focus on both indigenous understandings of risk and traditional/local knowledge of, change, hazards and coping strategies (Ellemor, 2005; Finucane, 2009; Turner and Clifton 2009), and combined collective responses (Brown, 2009). Lack of participation in international negotiations pose another risk for indigenous peoples in that their voices are not heard (Schroeder, 2010). On the other hand, with respect to hazardous substances that pose a clear risk that is exacerbated with climate change in the Arctic, indigenous groups have been engaged in direct lobbying and advocacy in an international context (Selin and Selin, 2008). Tourism development and industrial activities are particular risks for indigenous peoples when they are not involved in the decision-making processes, in particular where these are based in top-down institutions (Petheram *et al.*, 2010). There is a strong agreement among the studies, albeit with different solutions, that transfer of knowledge (Catto and Parewick, 2008), local participation, engagement, input to policy and decision making, and enhanced local understanding of the risks and problems (Bogale and Korf, 2009; Osbahr *et al.*, 2010) are salient factors of human security.

12.4. Migration and Mobility Dimensions of Human Security

12.4.1. Impacts of Climate Change on Displacement, Migration, and Mobility

12.4.1.1. Nature of Evidence on Climate Change and Migration

Migration is the movement of people from one location to another for a long time and over a significant distance. Migration includes the movement of people from a) rural to urban livelihoods (urbanization), b) temporary 'internal displacements' due to a natural hazard, conflict or a complex emergency or c) permanent internal, regional or international migration that may be voluntary or involuntary.

The largest trend in migration continues to be major movements from rural to urban settlements, and hence a major emphasis of migration research is on the challenges of migration for urban sustainability and climate impacts (Parnell and Walawege, 2011; Seto, 2011). The proportion of urban population globally has risen from 10 percent in 1900 to over 50 percent in 2009 and is projected to 59 percent by 2030 where over 90 percent of this increase will be located in cities in the developing world (UNDP 2009; Grimm et al., 2008). Around 20 percent of global migration is international (Julca, 2011).

The scientific literature on the interaction of migration with climate change is limited in terms of future predictive models. But there is a growing literature on the demographic, economic and social processes of climate migration interactions (Piguet et al., 2011; Afifi and Jäger 2011; Serrano et al., 2013). The most common methods used to examine the actual processes of migration and climate change risks include statistical inference to explain observed migration patterns with climate or related impacts as independent variables; sample surveys of actual migrants to explain their individual drivers of the decision to migrate; and other modelling techniques and indepth qualitative studies designed to explain the social processes and context by which migration decisions are made, often using historical analogies (McLeman and Hunter, 2010). Some modeling studies project impacts of climate change on the viability of continued habitation and examine the impact of rainfall decline or land inundation as a risk factor for the displacement of people. These studies have, for risks such as sea level rise, quantified potential displacement (Nicholls et al., 2011). As with all the major elements of human security in this Chapter, the issue of causality between environment or risk and the human security outcomes of migration are not established. Piguet (2010) concludes that 'there is no established methods of providing overall quantitative predictions concerning additional human migration that might be caused by climate change' (Piguet, 2010, p.517), and that the methods adopted so far give contradictory findings.

12.4.1.2. Do Climate Change Impacts Increase Displacement or Restrict Mobility?

There is strong evidence that populations have been displaced or forced to move by extreme weather events and by gradual climatic changes that affect the availability of ecosystem services making settlements less economically viable. The direct mechanisms by which climate change may affect human security are through reduced agricultural productivity; heightened water insecurity; increased exposure to flooding and extreme weather; and increased health risks. The evidence base on migration response has examined most mechanisms.

Table 12-3 summarises studies on weather extremes and long-term environmental change with migration outcomes showing that some events and trends lead to increased displacement of populations (column 1); while others lead to reduce mobility and significant trapped populations (column 2). Table 12-3 also demonstrates that in many circumstances (column 3) sections of populations are differentially affected, on the basis of ethnicity, wealth or gender (Grey and Muller, 2012; Upton, 2012; Elliot and Pais, 2006). New models address the distinction between displacement and the potential for populations to be trapped due to climate change (Black et al., 2012; Renaud et al., 2011). Research on migration outcomes has focused both on circumstances with significant climate-related impacts (drought, floods and landslides), or has sought to identify a climate signal in observed movement of people (Oswald et al., 2013). Table 12-3 therefore demonstrates that the key impacts of climate change include increased displacement; reduced mobility and trapped populations; and migrant populations moving towards destinations likely to be more hazardous due to the impacts of climate change (Balck et a., 2011a).

[INSERT TABLE 12-3 HERE
Table 12-3: Empirical evidence on observed or projected mobility outcomes (migration, immobility, or displacement) associated with weather-related extremes or impacts of longer-term climate change. Note that direct causality is difficult to detect or infer in many studies.]

Modelling studies with future projections on Mexico-US migration rates (Feng et al., 2011), and on Brazilian internal migration (Barbieri et al., 2011) show that projections of drying increase emigration in established migration routes and de-population of rural areas (Kniveton et al., 2011). Other studies highlight that significant parts of population experience reduced mobility (van der Geest, 2011; Sánchez et al., 2012; Findley (1994) and long distance migration is reduced by drought in pastoral systems. All pioneer migration to urban centres requires significant human and financial capital and hence is restricted to wealthier populations. Henry et al. (2004) confirmed in a multi-year study of Mali that the movement to other rural areas increased in dry years, but long distance or international migration was limited to years of high agricultural productivity. Kniveton et al. (2011) models migration movements from the 1980s in Burkina Faso and, similarly to Henry for Mali, projects that future scenarios of decreased rainfall would significantly increase rates of out-migration from rural areas.

One consistent theme is that while migration responses to climate-related hazards are common, movement is costly and disruptive and hence may only be used as an 'adaptation of last resort' (McLeman, 2009). Hurlimann and Dolnicar (2011) showed for eight Australian settlements that relocation and migration was perceived to be the least desirable adaptation. Haug (2002) showed that pastoralists displaced due to drought in Sudan in the 1990s attempted to return to their previous settlements after the drought, notwithstanding conflict and other factors.

While the number of people displaced by major hazards may be large, migration is not the dominant response in most cases. McLemman and Hunter (2010) reviewed historical cases of displacement migration and concluded that non-migration or rapid return migration significantly outweighs permanent migration following hurricane impacts in the Caribbean, Dust Bowl migration in the 1930s USA, or dry season migration in the West African Sahel.

Changes in resource scarcity in rural areas in the developing world significantly affect migration decisions, but the evidence is mixed on whether they amplify existing migration trends. Barrios et al. (2006) used statistical modelling of changes in rainfall to explain migration rates to African cities. Their observed rainfall decreases during the past fifty years explained some differences in urbanization rates, with shortages in rainfall increasing urbanization in sub-Saharan Africa, often propelled by simultaneous liberalization of movement.

Increased exposure to flooding and extreme weather is associated with significant displacement of populations as settlements and homes are directly affected. Much evidence shows a distinct temporal dimension to displacement ranging from localised and short-term movement of people, through intra-regional migration to international displacement as a result of large-scale events. The Pakistan floods of 2010 caused primarily localised displacement for large numbers of people across a wide area (Guarev et al., 2011). The evidence on displacement as a result of climate-related extremes suggests that most displaced people attempt to return to their original residence and rebuild as soon as practical. There is some conflicting evidence on whether migration is the dominant response to such events.

Paul (2005) found that there was little displacement in Bangladesh as a result of flooding in affected villages and that residents perceived an influx of migrants due to the reconstruction. Structural vulnerabilities affect the ability to cope without migrating. Hurricane Mitch affected different Central American countries and displaced up to two million people either temporarily or permanently. The impact was highly differentiated by country, with much lower displacement rates in Belize compared to Nicaragua, Honduras and El Salvador with large scale displacement and an increase in international migration of 300 percent from Honduras (McLeman and Hunter, 2010; Glantz and Jamieson, 2000). But the impacts of such events are highly uneven. While the poorest households in Honduras were hardest hit by the hurricane (McSweeney and Coomes, 2011), but they were less vulnerable to storms in the late 2000s due to changes in land tenure and support and to community early warning systems (Villagrán, 2009).

In general, structural causes of vulnerability, such as income inequality, race, class, discrimination, deeply affect the livelihood of displacement and the consequences for return. The migration associated with Hurricane Katrina shows that in New Orleans economically disadvantaged populations were displaced in the immediate aftermath and have not returned (Myers et al., 2008). Fussell et al. (2010) found that 14 months later black residents returned more slowly, because they had suffered greater housing damage. Adams et al. (2009) identified factors that have led to 'chronic disaster syndrome' that means that some populations are unlikely to return, and Hori and Shaefer (2010) suggest that displacement affected human security through housing, economic and health outcomes. Women are more at risks through extreme events, especially when they lose their social networks or their social capital, and are often affected by mental health problems in refugee camps (Wind et al., 2011; Oswald, 2008).

There is some evidence that new migrants are more at risk in cities and cluster in high-density areas with exposure to flooding and landslides. Migrants in Buenos Aires, Lagos and Dakar (Mehrotra et al., 2011; World Bank, 2010) are more likely to be exposed to weather-related hazards than long-term residents. In Dakar (1998-2008), 40 percent of new migrants resided in areas with high flood risk. Wang et al. (2012) found that migrants had less knowledge about typhoon risks in Shanghai. Tompkins et al. (2009) showed that new migrants in the Cayman Islands are most vulnerable to tropical cyclones as they are least likely to prepare for cyclones, live in locations with high exposure to cyclone impacts, and interact mostly with expatriates without previous cyclone experience.

Long-term environmental change, sea-level rise, coastal erosion, and loss of agricultural productivity (Table 12-2) will have a significant impact on displacement. Barbieri et al. (2010) estimated emigration rates in Brazil from affected rural areas and found that de-population occurs with relatively modest rates of warming. In their scenarios the biggest increase in migration comes from productive agricultural areas that support a large labour force. Medelsohn et al. (2007) concluded that in dryland Brazil urban migration is highly likely due to agricultural income loss.

Nicholls et al. (2011) estimate displacements based on potential sea-level changes till 2100. A 0.5m sea-level change implies a likely land loss of 0.877 million km^2 by 2100, displacing 72 million people, with no adaptation investment and with 2.0 metres, 1.789 million km^2 would be lost, displacing 187 million people, or 2.4 percent of global population, mostly in Asia. If all coasts were protected with dikes and beach nourishment, these estimates fall to 0.041-0.305 million people displaced by 0.5-2.0 m of sea level rise. Hallegatte et al. (2011) assume that such protection measures are very likely as the cost of not investing in protecting urban land and infrastructure is so great. Existing migration trends are also likely to exacerbate impacts of climate change and vulnerability themselves. There is a well-documented drift of population into coastal and regional settlements. Curtis and Schneider (2011) project 12 million people to be affected by sea-level rise by 2030 in four major coastal areas in the US.

Mortreux and Barnett (2009) found that migration from Tuvalu was not driven by perceptions of climate change and that despite forecasts that the island could become uninhabitable, residents have remained for reasons of culture and identity. Shen and Gemenne (2011) concur that both Tuvalu residents and migrants from Tuvalu in New Zealand did not cite climate change as a reason for movement. Both studies also argue that environmental risks directly affect perceptions of potential well-being and economic opportunities: hence the impacts of climate change may be a more significant driver of future international migration. Observational studies of international migration show that past migration flows are the greatest predictors of future flows because of identity and cultural linkages in both source and destination regions (Serrano, 2012).

Marchiori and Schumacher (2011) found that climate change impacts tend to increase international migration rates and that investment in green technology bringing convergence in real wages, reduces international migration. Feng et al. (2010) examined for Mexico whether agricultural productivity, affected by rainfall, is a significant explanatory variable for emigration to the US. Their estimates show a tendency for emigration when crop yields decline. They used these coefficients to project emigration rates until 2080. Their projections show between 2 and 10 percent of the working age population of Mexico could potentially migrate to the US. These projections ignored the social and demographic elements or the role of circular transnational migration. The implications of rural depopulation could be profound. Radel et al. (2010) showed how farming households in Mexico adapt labour practices giving women greater autonomy affecting food security and sustainability. At the municipal level, Oswald (2013) observed abrupt demographic changes in drylands from 2000 to 2005 compared with 1990 to 2000, not only

caused by drought, but also due to changes in rural policy and higher imports of basic food, where the poorest states of Mexico (Guerrero, Oaxaca, and Chiapas with 72 per cent of poor people) had the lowest population movements.

12.4.2. Migration as an Adaptation to Climate Change Impacts

From a human security perspective migration and mobility are adaptation strategies that reduce risks in highly vulnerable places. Much literature has argued for greater emphasis on mobility within adaptation policies (Barnett and Webber, 2010; Bardsley and Hugo, 2010; Warner, 2010; Gemenne, 2011), examining contemporary migration; the vulnerabilities of migrants in destination regions and the efficacy of policies designed to assist them. This emerging literature focuses on four areas of government intervention: a) social protection mechanisms such as cash transfers to reduce the likelihood of temporary displacement from weather-related extremes (Johnson and Krishnamurthy, 2010); b) adaptation in destination regions, by reducing the vulnerability of migrants in growing urban areas; c) protection and assistance of migrants as they move with rights to citizenship and ability to make economic linkages to source regions and countries; and d) dealing with the prospect of relocation of settlements.

Relocation of populations and settlements is most often portrayed as a failure of adaptation and a policy of last resort (Barnett and Webber, 2010; Fernando et al., 2010; Hugo, 2011; de Sherbinin et al., 2011). There is some documented examples of settlements that are already planning for their own relocation, such as five indigenous communities in Alaska that are threatened with increased erosion, loss of ice cover and flooding over the past decades (Bronen, 2010). These settlements have undertaken planning for relocation and have received government funding for these processes. In line with all major analyses in this area, Bronen (2010) concludes that while the relocations are feasible, cultural and psychological elements at individual and community level are difficult to assess. There is significant resistance to relocation, even where such options are well planned and have robust justifications, as demonstrated by (Marino, 2012) for relocation in Alaska.

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Box 12-3. The Evidence on the Existence of Environmental Migrants and International Policy to Protect Them

Much of the current scientific literature suggests that attempts to define and quantify displacement as the prime migration issue are inadequate. The estimates of 'environmental refugees' proposed by Myers (2002) and others, for example, and repeated in policy documents, have been widely criticised (Black et al., 2011; Taccoli, 2009; Piguet, 2010; Jakobeit and Methmann 2012). Most present research focuses on the multiple drivers and on migration processes and shows that models of displacement fail to include other adaptation strategies (Gemenne, 2011).

For international displacement and migration, there is a growing literature on the nature of displacement; whether there are governance mechanisms facilitating migration at present; and the optimal design of such mechanisms in future (e.g. Biermann and Boas 2009, Williams, 2008; Bryavan and Rajan, 2006; Docherty and Giannini, 2009; Martin, 2009; McAdam, 2012). This literature focuses on strategies for adaptation, mitigation and resilience building, and concludes that significant adaptation may be required to protect and to empower internal or international migrants triggered by climate change. Several legal proposals have been analysed by socio-legal studies suggesting new multilateral conventions, or compensation mechanisms to countries where the population is forced to migrate (Bierman and Boas 2012).

Much public discourse in this area, refer to refugees, but there is widespread agreement in the scientific and legal literature that such use is 'erroneous as a matter of law, and conceptually inaccurate' (McAdam, 2011, p. 102). The arguments put forward for a specific legal instrument to deal with migrants who have been displaced as a direct result of climate change impacts include issues of rights given that such migration is imposed and involuntary (Bell, 2004); the scale of the potential issue with the potential for large populous areas to be inundated in the future due to sea level rise in particular (Bates, 2002); and the particular status of small island nations where displacement could affect sovereignty (Biermann and Boas, 2009; Williams, 2008; Owens, 2008).

New international governance mechanisms for international displacement address the difficulties to develop such an instrument in international law. Most migration and climate studies point to the environment as triggers and not causes for migration decisions. Some focus on the geo-political implications of changing the Geneva Convention on refugees to include environmental migrants as well as the lack of global instruments to handle internal displaced peoples or international migrants (Martin, 2009; Cournil, 2011). Others discuss the implications of climate migrant status of international migration, where full citizenship and economic status in destination countries are often not realised (McAdam, 2011; Hartmann, 2010). Many small island countries are reluctant themselves to have their international migration designated as being victims of climate change (MacNamara and Gibson, 2009; Farbotko, 2010).

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12.5. Dimensions of Conflict and Vulnerability to Climate Change

12.5.1. Evidence on Conflict Associations with Climate Variability and Change

Research on the interactions between violent conflict, war, and climate change and variability is contested (Gleditsch, 2012), with significant non-convergence between models and research approaches. Much of the research is dominated by: research that explore the relationship between variability in climate with the incidence of war in the recent past (drawing on both statistical analysis and on accounts of mechanisms within specific conflicts); and research that explore the relationship between large-scale disruptions in weather regimes and civilization collapse in longer time-frames (using statistical analysis and data derived from archaeological and others sources).

With regard to recent conflicts, the analysis of the causes of civil conflict and war is well established. Civil war is generally defined as major organized armed conflict aimed at achieving a political objective such as seizing control of a government and has been studied extensively using quantitative and qualitative techniques (Blattman and Miguel 2010). Much analysis of broad patterns and causation of war shows that the level of economic development, type of political regime, demographic factors such as youth bulge, and existence of conflict in neighboring regions are critical risk factors in conflict. In effect, climate variability and change will affect conflict incidence, likelihood and persistence through its effect on these underlying causes of conflict and on the ability of institutions to manage and resolve conflict (Barnett and Adger, 2007; Buhaug et al., 2010).

Some studies of ancient civilizations have identified a statistical relationship between sharp drops in rainfall and available surface water and loss of political order and collapse, often involving war. For example, Buckley et al 2010 find that the timing of the collapse of the Khmer empire in the Mekong basin in the early 15th century corresponds to an unusually severe prolonged drought, in which rainfall fell to levels not otherwise seen over hundreds of years. They connect this drought to difficulties in maintaining the empire and becoming vulnerable to external invaders, using archeological evidence. DeMenocal (2001) summarizes similar evidence for five other cases – the Anasazi, the Akkadian, Classic Maya, Mochica, and Tiwanaku empires. The documentary evidence in this area suggests that major changes in weather patterns coincided with the collapse of several previously powerful civilizations. The precise causal pathways that linked the two are not as well understood, owing to data limitations. And the question of the degree to which current large-scale political collapse is made more likely because of predicted climate change remains contested.

There is very little evidence linking international war systematically to climatic factors. A small number of scholars have argued that the timing of international war in Europe is correlated with the emergence and disappearance of the Little Ice Age (e.g. Tol and Wagner 2010), and Hsiang et al. (2011) find that in countries that are teleconnected to physical ENSO effects the risk of war within countries rises significantly during an ENSO period.

Several studies have found a statistical relationship between interannual climate variability and the likelihood of new internal wars. These studies tend to use rainfall as the climate measure, and tend to focus on the period 1980 to the present because of the availability of satellite-enhanced global rainfall measures for that period. During this period, regions experiencing marked drops in rainfall compared to normal experienced significantly higher risk for internal

war emergence (Miguel et al 2004, Hendrix and Glaser 2007). Burke et al. (2009) found a similar result for temperature anomalies. All of these studies characterize the effect of rain shortfalls in probabilistic terms in a context in which multiple risk factors are relevant. Where other risk factors are extremely low (as in wealth democracies), the impact of rainfall is virtually zero. There is significant uncertainty around model specification and the reliability of data in these areas of research (Buhaug, 2010; Hsiang and Burke, 2012). Burke et al. (2009) sought to project incidence of internal war in the future using projected climate change as a driver suggesting that, based on the historically observed relationship between temperature change and war outbreak, one should expect the frequency of internal wars to rise significantly under climate change, but the robustness of the model may not allow for observed past correlations to be predictive of future events (Buahaug 2010).

There is general agreement in the literature that, while there is association between various elements of climate variability and the causal mechanisms of conflict, there is a significant need for theoretical models and detailed work on the social processes of conflict emergence and on institutional response (Buhaug et al., 2010; Gleditsch, 2012; Mutinho and Hayes, 2012; Barnett and Adger, 2007; Sheffran and Battaglini, 2011). A key issue remains as to what types of climate variability give rise to conflict. There is evidence, for example, that both increased rainfall (and hence increased availability of vegetation and grazing resources) and decreased rainfall in resource-dependent societies enhance the risk of localized conflict (Raleigh and Kniveton, 2012; Hendrix and Salehyan, 2012; Adano et al., 2012). Hence climate variability (Both drought and anomalous higher rainfall) would seem to have a significant role in the conflict landscape for these types of societies. In all such cases, the presence of institutional structures to manage conflict risk is highlighted as the critical factor in mediating such risks (Benjaminsen et al., 2012). At larger scales in the studies of transboundary resources, studies that assess adaptive capacity and conflict risks reach same conclusion: that resource scarcity or climate variability is likely to have a significant impact on conflict risks only where institutions are absent (Bernauer and Sigfried 2012; Milman et al., 2012; Goulden et al., 2010).

If climate change affects the macro-economic situation, or reduced the ability of states to provide adequate services and protection within their jurisdictions, these factors could indirectly affect the risk of civil conflict (Barnett and Adger, 2007). There is a well-established body of evidence that climate variability and increasing incidence of natural hazards directly affects macro-economic factors and overall economic growth, even if extreme events do not directly lead to conflict. Bergholt and Lujala (2012), Adam (2012) and Hallegatte (2012) show that natural disasters have a negative economic impact on growth, and therefore suggest that the resource base of governments is stretched, both through having to invest in reducing hazard impacts and through reduced revenue and taxation. Pelling and Dill (2010) discuss examples where natural disasters in thr past century have led to political upheaval and a renegotiation of responsibilities between states and citizens. Hence there is some indirect evidence to believe that climate variability will affect the indirect mechanism of governance ability that mediate conflict risks.

There are, in summary, strong theoretical reasons to hypothesise that climate change impacts create unstable environments in which the risk of localized or wider conflicts within countries would be elevated. These theoretical linkages are the impacts of climate change on the underlying, and well-established, causes of conflict. The most well-established risk factor for internal war has to do with the level of human well-being and individual human security. Sections 2, 3 and 4 above set out the evidence that climate change is likely to diminish well-being in significant numbers of people, many of whom are likely to be living in areas of significant risk of internal war, and hence climate change will elevate the risk of internal war through the negative impact on well-being. Present research has only partially illuminated the magnitude of this risk and the social processes and mechanisms by which such risks will be realized.

12.5.2. Human Insecurity Exacerbates Climate Impacts in Conflict and Post-Conflict Regions

12.5.2.1. Conflict and Environmental Resources

The vulnerability of individuals, communities and states to the impacts of climate change depends on a host of biophysical, social-economic, political and geographic factors. The capacity to cope with, and to effectively adapt to, climate change is also related to the resilience of local and state level institutions, infrastructures, technologies, and the availability of economic and human resources and capital (Nelson et al., 2007; Smit & Pilifosova, 2003).

Many of the capacities required to safeguard human security and to cope with climate impacts are the same capacities threatened by the presence of ongoing or recent conflict (Brklacich et al., 2010).

There is a strong body of evidence from development studies and political science that violent conflict and fragile states threaten human security and undermine the capacity of individuals, communities, and states to cope with the impacts of climate change. While the number of incidents of violent conflict has declined globally in the past three decades, violent conflict will almost certainly persist at significant levels in the coming decades (Goldstone et al., 2010). The evidence base suggests, with a high degree of confidence, that where violent conflict emerges and persists, climate stress is more likely to diminish human security than elsewhere (Barnett, 2006; Lind and Eriksen, 2006; Eriksen and Lind, 2009). These trends on the underlying vulnerability of post-conflict societies is backed by evidence showing that their overall governance effectiveness is reduced, with implications for human security in the face of environmental risks (Adger, 2010), as illustrated in Figure 12-1.

[INSERT FIGURE 12-1 HERE
Figure 12-1: Conflict and post-conflict societies exhibit low levels of governance and human development. Source: Adger (2010).]

Existing research allows for initial findings to be drawn about how violent conflict can degrade and reduce access to environmental resources, impact economic wellbeing, reduce social cohesion, damage key institutions, and reduce state capacity - such that the capacity of individuals and communities to cope with the impacts of climate change may be limited (Barnett, 2006).

Violent conflict affects individuals and communities whose livelihoods rely heavily on the natural environment (Pike, 2004; Raleigh, 2011). The capacity to access environmental resources of sufficient quality and quantity to sustain livelihoods becomes a key aspect of human security and of the capacity to cope with changes in climate (Rowhani et al., 2011).

The denial of strategic space in violent conflicts has, for example, resulted in the destruction of crops in Eritrea, draining of marshland in southeastern Iraq and the widespread presence of landmines in conflict affected regions. This denial of access and mobility can reduce the capacity of individuals and communities to access agricultural land and vital environmental resources (Berhe, 2007; Unruh, 2011). Where rape is used as a weapon of war, women and girls (often required to perform household duties such as the collection of water) are particularly at risk of abuse as they attempt to access vital environmental resources (Detraz, 2009).

Conflict can degrade the quantity and quality of resources available or lead to these resources being exploited inefficiently. Chronic political instability in Zimbabwe, is, for example implicated in high levels of illegal bush meat hunting. It is estimated that illegal hunter's earnings account for only 0.3-0.5% of the financial losses incurred by the practice (Lindsey et al., 2011). Conflict, and the displacement of large populations, can also alter the abundance and distribution of biodiversity and can result in significant deforestation (Chase & Griffin, 2011; Lindsell et al., 2011; Stevens et al, 2011).

Armed conflict can also lead to ongoing cycles of food loss and food insecurity (Messer & Cohen, 2011). Although cross-national evidence is limited, one such study found a statistical relationship between conflict and depressed yield from fisheries (Hendrix & Glaser, 2011).

Conflict disrupts markets and destroys infrastructure, limits education and the development of human capital, causes death and injury among a state's workforce, and decreases the ability of individuals, communities and the state to secure credit (Goodhand, 2003; Stewart et al., 2001). Conflict thus creates poverty, which by many measures, increases vulnerability to the impacts of climate change.

At the household level, the threat or consequences of violence can degrade livelihoods and lead to survival strategies that jeopardize long term prosperity (Nigel, 2009). A study of livelihood diversification in South Sudan finds that livelihood diversification may not hold the same promise as a response to vulnerability in the context of ongoing insurgency as it does in non-conflict contexts (Deng, 2010). Many displaced returnees in post-conflict Liberia for

example, appear 'trapped' within the artisanal diamond sector in a coping cycle of subsistence survival that exacerbates the threat of future shocks (Hilson & van Bockstael, 2011).

When conflict limits the economic options available to individuals and communities and destroys productive assets (both physical and human), the vulnerability of individuals, communities, and states to shocks such as climate change increases.

12.5.2.2. Conflict and Social Capital

The capacity for collective action is a critical determinant of the capacity to adapt to climate impacts. Yet violent conflict can devastate social networks, social capital, and overall social cohesion (Barnett, 2006). This complex relationship depends on the form of violence and the strategies households adapt in response (Deng, 2010a & 2008). However, where conflict exacerbates existing horizontal inequalities between ethnic or religious groups, foments distrust in local or government institutions, or isolates individuals and households, capacities that are critical to coping with climate impacts are also degraded.

Customary mechanisms for distributing resource access often depend on high levels of trust between different communities. This trust dependence is vital for agro-pastoralist communities whose resource dependent livelihoods place them at high risk to changes in climate (Bogale & Korf, 2007). A case study of two communities in Kenya finds that where local scale conflicts such as cattle raiding and hustling are common, the social ties required to bind communities and to effectively manage resource scarcities can be strained (Adano et al., 2012; Eriksen & Lind, 2009). Conflict strained social relations may be more brittle, and break down more easily, should future climate impacts exacerbate such scarcities.

Conflict related displacement also creates and exacerbates social isolation and accompanying sources of vulnerability. Isolation from social networks can make it difficult to achieve pillars that underlie traditional livelihoods, such as marriage, access to land, or access to communal social safety nets in times of vulnerability (Goldsmith, 2001; Raleigh, 2011).

Finally, efforts to address climate change in this conflict context, without addressing conflict related sources of social divisiveness, may compound these divisions where such efforts provide financial or resource flows, or political levers that can be captured by local elites or illegitimate institutions (Brown et al., 2011; Verhoeven, 2011).

12.5.2.3. Conflict and Local and State Institutions

Local and state level institutions play an important role in mediating the use of environmental resources, in supporting livelihoods, in supporting basic infrastructure, and in responding to climate impacts. However, conflict can decrease the capacity of these institutions to function effectively (Feitelson et al., 2012; Tignino, 2011).

Chronic political conflict has reduced the ability of governance institutions at many scales to effectively manage water resources in the Gaza Strip (Shomar, 2011), parts of the Balkans (Skoulikidis, 2009), and the Middle East (Zeitoun et al., 2012). Instability has affected planning process around urban land use in Palestine (Raddad et al., 2010) and traditional institutions for governing fishery rights in the Lake Chad Basin have been challenged by the presence of armed groups and illegal taxation systems sustained by non-legitimated government agents (Bene et al., 2003). Political instability has also been shown to contribute to poor urban governance in some regions of Iraq (Hassan, 2010).

Fragile institutions may limit the ability of conflict affected states to prevent and respond to natural disasters and humanitarian crisis (Keen, 2008). A lack of trust in government commitment or capacity to respond, the presence of police or military forces that lack legitimacy, or recent conflict between government and local forces, hampers the ability of these institutions to provide effective relief (Wisner, 2001). Legacies of conflict can also multiply long

term and chronic sources of underlying vulnerable among affected populations, such as empirical evidence from Timor Leste demonstrates (Barnett et al., 2007).

The effect of conflict on the institutions responsible for controlling access and exploitation of natural resources is important for specifying climate change, natural resources, and conflict links. Case study evidence suggests it is primarily the institutional framework of a locality that determines the potential for violence in disputes over scarce resources (Adano et al., 2012).

12.5.3. Conflict and Insecurity Associated with Climate Policy Response

As actions to mitigate and adapt to climate change become more widespread, research is beginning to address the conflict potential or realized conflict that may result from these actions (Bumpus and Liverman 2008; Adger and Barnett 2009; Dabelko 2009). There are documented risks that actions taken in response to climate change aggravate significant inequalities or grievances (Adger et al., 2006), play into political bargaining, limit access to land and other resources required to maintain livelihoods, or otherwise undermine critical aspects of human security. Instances of maladaptation or greenhouse gas mitigation efforts at odds with local priorities and property rights increase the risk to populations and may increase the risk of conflict (McEvoy and Wilder, 2012; Beymer-Farris & Bassett, 2012; Barnett and O'Neill, 2010). This potential may increase where the state is already fragile and its institutions weak.

Research on the rapid increase in biofuels finds evidence connecting "land grabbing," land dispossession, and social conflict (Molony and Smith 2010; Borras Jr. et al. 2010; Dauverge and Neville 2010; Vermeulen and Cotula 2010). Some research has identified links between increased biofuels production, food price spikes, and social instability such as riots.

Projections identify changing land access rights and the provision of financial resources in payment for ecosystem services projects of such as Reduced Emissions from Deforestation and Forest Degradation (REDD) as a potential cause of social conflict between resource users and government authorities. Efforts to ensure 'REDD readiness' in Tanzania (Beymer-Farris & Bassett, 2012) and the Congo basin (Brown et al. 2011) have placed communities opposed to marginalization and displacement in conflict with conservationists and governments. In Sudan, there is some evidence to suggest that the deployment of neo-Malthusian narratives linked to climate change have disproportionately benefited elites at the cost of local communities (Verhoeven, 2011). Eriksen & Lind (2009) likewise find that climate change adaptation in Kenya are shaped by and may even play into "existing power structures and conflicts of interest" and thus have the capacity to aggravate surrounding conflicts (Eriksen & Lind: 817).

The increased deployment of renewable energy technologies that have historically resulted in social conflict and human insecurity (forced resettlement from large hydropower infrastructure projects) is a basis for projections of greater social conflict (de Sherbinin et al. 2011; McDonald-Wilmsen et al 2010; Conca 2005). Other research points to an increased use of nuclear power increasing the threat of nuclear proliferation or incidents of nuclear terrorism (Socolow and Glaser 2009).

The evidence base is emerging and limited as relevant climate policy actions are still evolving and not yet in widespread use for sustained periods. While this literature is still emerging, violent political struggles have, and seem likely to continue, to occur over the entitlement and distribution of environmental resources (Peluso & Watts, 2001). It appears likely that where efforts to mitigate or adapt to climate change interact with these entitlements and distributions, the potential to create and aggravate societal conflicts may exist. To avoid maladaptation and new insecurities as result of climate policy, and their potential to provoke conflict, much of the research in this area suggests greater focus on equity dimensions in decision-making (Marino & Ribot, 2012).

12.5.4. Peace-Building Activities in Promoting Adaptation

Research on natural resources and conflict management has developed in conjunction with conflict causality research. It has also extended beyond questions of whether natural resource scarcity or abundance causes conflict to include periods before, during, and after the onset of conflict (Hammill and Matthew 2012). The research has also gone beyond causality to focus on natural resource management as a means to reduce conflict and enhance cooperation. This research is at times termed environmental peacebuilding or environmental peacemaking and at other times is merely folded into larger conflict management frames.

Natural resource management is conflict management, channeling competing interests over resource control and use into non-conflictual resolutions. Environmental peacebuilding is explicitly integrating natural resource management into wider conflict termination and post-conflict peacebuilding efforts. The connections between resources and livelihoods and poverty alleviation, employment, and food security form the basis on making natural resource management a priority component of peacebuilding rather than a second term concern. Proactive environmental peacebuilding attempts to capitalize on mutual environmental interdependence to form patterns of ongoing cooperation over time. This joint management, even in times of active conflict, can occur among states and among civil society or scientific non-state actors. Evidence remains based on case studies rather than systematic reviews by resource type, level of political organization, and position along a conflict continuum.

Connections between environmental conditions, market conditions and agriculture have led to the development of early warning systems regarding famine and food insecurity. These systems take account of climate change and serve as a tool for anticipating food insecurity and potential population insecurities (Verdin et al. 2005). The Famine Early Warning System Network (FEWS Net) is designed to anticipate food security crises and to mobilize resources and response to reduce human insecurities and wider social conflict. Research suggests climate change will make early warning systems and targeted development will be increasingly critical to avoid food insecurity and it contributing to wider human insecurity and social conflict (Brown and Funk 2008).

Research on bilateral and multilateral interactions between two or more states from 1948 to 2008 shows evidence of significant formal cooperation among river basin riparian states while the majority of interactions are low levels of cooperation and low levels of conflict (Wolf et al, 2003; De Stefano et al. 2010). The evidence suggests only a limited number of overtly violent conflicts between states and no cases of water causing two states to engage in formal war. Transboundary water cooperation, particularly joint management, flood control, and technical cooperation, form a basis for longer-term iterated cooperation. Efforts at basin wide institutional development to lower conflict potential focuses on moving from the common assertion of rights to water to assessing the multiple needs for water (irrigation, transport, industrial, energy, ecosystem services, household use, identity) to sharing benefits within the basin across national boundaries (Sadoff and Grey 2002). Key principles of the 1997 UN Convention on Navigable Watercourses, such as no significant harm and prior notification, are increasingly included in informal and formal transboundary water institutions to reduce conflict and enhance cooperation despite not having the force of formal international law (McCaffrey 2000; Dellapenna and Gupta 2009).

Zeitoun and Warner (2006) and Zeitoun and Mirumachi (2008) distinguish between equitable and inequitable cooperation among transboundary riparians cooperating through joint water management institutions. Relative power differentials between countries, territories, and/or groups stemming from upstream/downstream position, economic power, or military power can undercut the wider conflict reduction impacts of formal institutional cooperation.

Other efforts to enhance cooperation and lower conflict around natural resources have less evidence on effectiveness. Some transboundary conservation areas, referred to as “peace parks,” are designed to reduce conflict and enhance cooperation across borders. Evidence is limited in terms of cross-case comparisons of the efficacy of peace park efforts and peacebuilding. Analysis using case study methodologies analysis finds some evidence of economic and conservation cooperation and some evidence of conflict generation between local communities, elites and states (Duffy 2002).

12.6. National Security

12.6.1. Geopolitical Issues

Analysis of the actions of states and security institutions show that many states view current and anticipated climate changes as contributing to geopolitical concerns (Dabelko 2010; Smith 2011). The ability of states to share resources, including the global atmosphere, and to provide the environment for human security, are challenged by climate change impacts. Changes in the availability of resources (scarcity and abundance), and the potential deployment of large-scale geo-engineering interventions to respond to climate change are examples where states perceive climate change may pose explicit geopolitical concerns.

Other geopolitical concerns relate to opening of resources, such as the social, economic and political dimensions of loss of sea ice in the Arctic (Box 12-4), which represents an example of climate change impacts being significant to states and their relations, even in the absence of direct conflict.

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Box 12-4. Evidence on Security and Geopolitical Dimensions of Climate Change Impacts in the Arctic

Impacts of climate change on the Arctic region exemplify the multiple interactions of human security with geopolitical risks. System wide changes in the Arctic region have implications for multiple countries but also impact on a global commons resource, since the Arctic plays a significant regulating role in global climate and ocean systems (Carmack et al., 2012; Duarte et al., 2012). The dimensions of insecurity created by projected future environmental change in the Arctic region include: livelihood, biological resources and food insecurity with affecting specific cultures and knowledge systems (outlined in Section 3); energy security implications through opening of sub-sea oil and gas reserves; and the potential militarization of the region. Some risks may intersect, such as in the Barents Sea where present important fishing grounds would be impacted by expansions in petroleum development and increased shipping put pressure on the environment, and spawning grounds for commercial fisheries such as cod may shift significantly (Berkman, 2012). Most analysis categorizes such changes and interactions as increased regional instability and which require new investment in conflict resolution resources.

Summer Arctic ice has had five of the lowest recorded minima in the period 2007-11 (Duarte et al., 2012), and projections of future loss suggest an ice-free Arctic ocean in summer by mid century or before with implications for land based infrastructure, shipping, coastal communities and transport (Holland et al., 2006; Stephenson et al., 2011; van Oort et al 2011). These changes are creating and reviving terrestrial and primarily maritime boundary disputes among Arctic countries (Borgerson, 2008; Lusthaus 2010). Research on geopolitical risks and on international relations and institutions provides a near consensus that there is little evidence that it will become a site for violent conflict (Berkman, 2010; Brosnan et al., 2011; Young 2009; Young, 2012), given the political institutions such as the Arctic Council are also providing a forum for resolving resource sharing. Research on livelihoods and cultural change dimensions of human security, however, also converges on concluding that climate and ecological shifts, along with other stresses in the Arctic will create significant challenges for adaptation, beyond the experience of all settlements and northern countries and peoples (Nuttall, 2012; Hovelsrud et al 2011).

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A significant proportion of freshwater resources are shared by states within transboundary basins. Hence, the impacts of climate-induced water variability on transboundary water basins constitute a cluster of geopolitical concerns. The high levels of international interdependence on transboundary rivers such as the Nile, Mekong, and Indus connect the conditions of the rivers with national level development trajectories. Climate change is anticipated to affect the timing and rate of flow of these rivers, contributing to concern over negative development and political outcomes from additional stresses stemming from increased consumption and increased populations. Shared river basins have increased risk of state-to-state or dyadic conflict (Gleditsch et al. 2006). Research on transboundary conflict and cooperation prioritizes rate of change rather than absolute scarcity in connection with the risk of conflict over water, particularly between states. This focus stems from higher perceived risk of conflict when institutions at

local, state, and regional levels have less time to adapt to scarcity or variability through channeling disputes through non-conflictual mechanisms (Wolf et al. 2003; De Stefano et al. 2010; Wolf et al. 2011). Sudden changes in flow that heighten risk and challenge institutions can stem from hydropower development, from changes in states (internationalization of subnational rivers through creation of new states) or from declines in seasonal snow or glacial melt. Transboundary basin institutions and international legal mechanisms have demonstrated the ability to lessen the likelihood of violent conflict (Tir and Stinnett 2012). Yet these transboundary water institutions receive limited financial and political investment, often do not include all riparians, and are present in only xx% of transboundary basins (Conca et al, 2002; Wolf et al. 2011).

Geoengineering, the large-scale manipulation of the atmosphere, is increasingly discussed as a strategy to address climate change. Interventions are designed to increase the carbon sink function or block solar radiation. The uncertainty and high likelihood of differential impacts of deployment on states (such as reduced precipitation in Asia (Ricke et al. 2011) with negative food production implications), are cited as anticipated sources of tension or conflict between states (Robcock 2008a; 2008b). The ability of states to unilaterally deploy geoengineering in a policy environment with little established international legal mechanisms or precedent creates geopolitical concern through the potential for conflict. The likelihood of military and security institutions involved in both deploying geoengineering technology and responding to geoengineering deployment, raises concern over the securitization of climate change policies and responses to them. This securitization concern further stems from the dual use potential of geoengineering that could be utilizied as a weapon as well, potentially in violation of the 1977 UN Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (Keith 2000; Corner and Pidgeon 2010; Goodell 2010; Robock 2008a; 2008b).

12.6.2. Critical Infrastructure and State Capacity

Climate change is expected to damage a range of critical infrastructure in many parts of the world, with water and sanitation, energy and transportation infrastructure posing especially severe vulnerabilities (AR5, WG2, ch. 8; Rozenzweig et al 2011; UN Habitat 2011). Climate change is expected to exacerbate water supply problems in sensitive urban areas, to limit the ability to cool power plants, to increase energy demand beyond capacity in areas of high temperature increase, to disrupt power supply and telecommunications in areas of increase snow and ice storms, and to damage vital transportation infrastructure in areas subject to flooding and storm surge (see Chapter 8). Areas that are vulnerable to flooding and landslides will have greater risk of such infrastructure damage (Adelekan 2010, Awuor et al. 2007, Revi 2005).

Where infrastructure damage generates large impacts that affect many people for significant periods of time, it will be experienced by people and states as a security problem, both because of the direct effects on societies and on the indirect effects stemming from reduction in the ability of the state to project force and to safeguard citizens well-being.

Climate change impacts will reduce the ability of some states to provide social and public services (see Chapter 8). Such capacity reductions stem from the effect of climate change on critical infrastructure. For example, power outages stemming from water shortages or storms can in turn lead to reductions in service delivery on the part of hospitals, policy forces and emergency response forces. Damage to roads, rails, airports, bridges and related transport infrastructure can similarly reduce the ability of governments to provide for citizen needs. In countries that are already poor and whose economies depend heavily on climate-sensitive activities such as agriculture, climate impacts are likely to lead to significant declines in income and in turn government revenues. Mideksa (2010) estimates losses of nearly ten percent in Ethiopia GDP. Shilling (2011) demonstrates that climate shocks lead to significant reductions in government revenue in sub-Saharan Africa.

In extreme cases climate change threatens the viability of states. For small island states, and countries with significant areas of soft low-lying coasts such as Bangladesh, sea-level rise and extreme events threaten to erode and subsume significant proportions of land and associated infrastructure and settlements (see chapter 5). For the five countries comprised entirely of low-lying atolls, sea-level rise, ocean acidification, and increase in episodes of extreme sea-surface temperatures compromise the ability of atoll islands to sustain existing numbers of people, and

with projected high levels of sea-level rise beyond the end of this century, whole islands may be subsumed (see chapter 29). The thawing of permafrost will increasingly undermine settlements and infrastructure in high latitude areas (see chapter 28).

12.7. Synthesis

The evidence reviewed in this Chapter show that climate change poses risks to various dimensions of human security, which arise through diverse causal processes, and which will be manifest at different scales. There are multiple and competing perspectives on the nature and causes of insecurity arising from climate change (Barnett 2010). For example, farmers in the Sahel are concerned about the risks climate change poses to their livelihoods (Mertz et al. 2009), whereas people in Tuvalu report that the cultural impacts of migration are a primary concern (Mortreux and Barnett 2009). Organisations whose mandates include various aspects of human security also tend to focus on some risks of climate change over others. For example the International Council on Human Rights Policy is concerned with the risks climate change poses to human rights, the International Organization for Migration is concerned with the implications of climate change for migration, and the United States National Intelligence Council is concerned with the risk that climate change will increase violent conflict. In this respect the framing of climate change as an issue of human security facilitates conversations across the boundaries of diverse policy communities (Gasper 2010).

The risks that climate change poses to human security arise through multiple and interacting processes that operate across diverse spatial and temporal scales. The complexity is such that there is no conceptual model or theory that captures the full extent of the interactions between all of climate change, livelihoods, culture, migration and violent conflict, not can we construct one on the basis of the existing scientific literature. However, it is clear that there are feedbacks between the key elements of livelihoods, culture, migration, and violent conflict. In Figure 12-2, for example, deterioration in livelihoods is a human security issue in its own right, and also gives rise to migration, which may be adaptive, or unavoidable and undesirable: such movements in turn imply changes in important cultural expressions and practices, and, in the absence of institutions to peacefully manage the settlement of migrants in destination areas, can increase the risk of violent conflict, which can in turn undermine livelihoods, impel migration, and weaken valued cultural expressions and practices.

[INSERT FIGURE 12-2 HERE
Figure 12-2: Synthesis of evidence on the impacts of climate change on elements of human security and the interactions between elements.]

A key finding of this chapter is that institutions are integral to the risks climate change poses to all dimensions of human security reviewed. The risks climate change poses to human security rarely only arise through cascading material effects of changes in climate through environments to social systems. Most often the risks arises through ways in which institutions anticipate and react to these perceived or actual changes (Artur and Hilhorst 2012, Barnett et al. 2010, Ribot 2011). These institutional responses can significantly dampen or amplify the way changes in climate give rise to human insecurity (see Figure 12-2). For example, although declining productivity in crops and fisheries impacts on the food available to semi-subsistence farming and fishing households, anticipated or actual increasing scarcity on food markets also causes higher food prices are reduced access to food in these households (refs).

Adaptation and mitigation strategies can also dampen or increase human insecurity. With respect to both adaptation and mitigation strategies, there is an emerging consensus that those that are imposed on communities are more likely to impact on human security than those that facilitate communities to respond in ways that are consistent with their capabilities and values (Barnett and O'Neill 2012, Marino 2012, Mercer et al. 2012). Adaptation strategies that seek to reduce exposure to climate change, through the development of large infrastructure or the resettlement of communities against their will carry risks of disrupted livelihoods, displaced populations, deterioration of valued cultural expressions and practices, and in some cases violent conflict. Conversely, strategies such as the provision of microfinance, assistance to overcome barriers to mobility, and improving access to education ad health dare, enhance the ability of vulnerable populations to make and implement decisions that are consistent with their own

capabilities and values are likely to dampen the adverse effects of climate change on livelihoods, unwanted migration, culture, and violent conflict. Similarly, mitigation policies that entail changes in property regimes that are consistent with local desires can impact in human security (Beymer-Farris and Bassett 2012, Bumpus and Liverman 2008). There is as yet little evidence to demonstrate that mitigation activities that align with local interests and institutions can have co-benefits for human security, mitigation, and adaptation, although this would be certainly desirable (Moser 2012).

Thus, climate change is not yet the primary risk to human security (see Box 12-5). Climate change is one of many drivers of human security, with various contextual factors, such as poverty, discrimination on the rounds of gender, and inadequate provision of services such as electricity and clean water, and of opportunities such as education and health care, being more important factors at present. Careful decisions about institutional responses to facilitate adaptation can dampen many of the potential adverse effects of climate change on human security (see Figure 12-2). Conversely, inappropriate climate policy responses may accelerate and amplify human insecurity.

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Box 12-5. Climate and the Multiple Causes of Conflict in Darfur

Climate variability is popularly reported to be a significant cause of the mass killing in the Darfur region that began in 2003 (see Mazo 2009): long term drought and vulnerability of the population to drought identified as the trigger and cause. Five detailed studies of the conflict conclude that climate variability and related environmental changes are proximate but not primary causes of the violence.

The detailed studies find that the violence in Darfur has multiple causes, including:

- The legacy of past violence, which established groups that had a history of violent action, and a supply of weapons
- Manipulation of ethnic divisions by elites in Khartoum
- Weakening of traditional conflict resolution mechanism through government policies, and as a consequence of famines
- Systematic exclusion of local groups from political processes, including of the Fur, Masalit, and Zaghawa ethnic groups
- Limited economic development and inadequate provision of public services and social protection, stemming from governance and policy failures, political instability, and misuse of official development assistance
- Desertification, declining productivity of arable land, and increased aridity (Brown 2010).

All analyses agree that it is not possible to isolate any of these specific causes as being most influential (Hagen and Kaiser 2011, Kevane and Gray 2008, Sunga 2011, Verhoeven 2011). Most authors identify government practices as being far more influential drivers than climate variability, noting also that similar changes in climate did not stimulate conflicts of the same magnitude in neighboring regions, and that in the past people in Darfur were able to cope with climate variability in ways that avoided large scale violence.

These studies therefore dispute the identification of the Darfur conflict as being caused by climate change, arguing that attributing this conflict to climate change masks the culpability of actors and the major drivers of insecurity.

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Although there remains much uncertainty about the future impacts of climate change in human security, on the basis of current evidence about the changes in environmental conditions as warming increases, adaptation and its limits, and about progress in addressing many of the social drivers of human insecurity, climate change seems likely to be an increasingly important driver of human insecurity in the future (see Figure 12-2). At very high rates of projected warming, all of the aspects of human security discussed in this chapter seem likely to be adversely effects (see Box 12-5). At high rates of warming the extent of changes in environmental conditions in most places will be without any precedent in human history (New et al. 2011), and so the evidence about the effects of past and present changes

in climate on human security that informs much of the current literature on human security and climate change will be increasingly be of diminishing value in analysing the human security implications of rapid or severe climate change.

Frequently Asked Questions

FAQ 12.1: Are culture and traditional knowledge important for adapting to climate change?

Culture and traditional knowledge is deeply rooted in history and encompasses virtually all aspects of human life, and is therefore instrumental in shaping responses to climate change. Culture is for many indigenous and local communities constructed around livelihood activities, such as herding, hunting, fishing or farming, and contain the necessary knowledge to deal with highly variable environmental and societal conditions. Cultural perceptions of resilience to climate change, however, can either facilitate or hinder adaptation. Traditional knowledge is increasingly seen a critical source for both scientific understanding of the consequences of climate change and for developing successful adaptation strategies and policies.

FAQ 12.2: Will climate change impacts alter patterns of migration in vulnerable regions?

Patterns of international migration are well established and primarily driven by economic factors. Some migration flows are sensitive to changes in resource availability and ecosystem services and hence some rural to urban migration flows may be amplified by climate change impacts in developing and urbanizing countries. Migrants themselves may be vulnerable to climate change impacts, particularly in hazardous urban destinations. Given multiple motivations for all migration decisions, it is difficult to categorise any individual as a climate migrant.

FAQ 12.3: Will climate change impacts trigger or exacerbate violent conflict through making water and resources scarcer in vulnerable regions?

Climate change impacts will potentially contribute to the circumstances in which conflict will emerge in places prone to such risks already. The evidence is mixed that water scarcity is a primary route for such conflict, as both resource abundance and scarcity are factors in some conflict. And water scarcity or extreme events are minor factors compared to well-established economic causes of conflict. Populations in conflict zones are, however, extremely vulnerable to the impacts of climate change.

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Table 12-1: Observed and projected impacts of climate variability and change to basic needs and livelihoods undermining human security.

Dimensions of Impacts		Evidence from Observations	Projections
Deprivation of immediate basic needs	**Agriculture and food security**	• Interaction of climate change with poverty and other political, social, institutional and environmental factors adversely affects agriculture production and compound the problem of food insecurity in many parts of the world (Downing 2002; Trotman et al. 2009; Saldana-Zorrilla 2008; Kumssa and Jones 2011). • Examples: majority of the studies have focused in Africa, due to its over-dependence on rain-fed agriculture (Kumssa and Jones 2011; in Kenya, Oluoko-Odingo 2011; in Southern Africa, Dremie and Gillespie 2010; in Zimbabwe and Zambia (Mubaya et al. 2012).	• Studies in African agriculture using various climate scenarios indicate that increasing temperature and rainfall variation have serious impacts on crops and livestock production that are likely to lead to increased poverty, vulnerability and loss of livelihoods. • Examples: Ethiopia (Deressa and Hassan 2009); Kenya (Kobubo-Mariara 2009); Burkina Faso, Egypt, Kenya and South Africa (Molua et al. 2010); sub-Saharan Africa (Jones and Thornton 2009). • Livelihood insecurity among small-scale rain-fed maize farmers in Mexico predicted due to potential lost in traditional seed sources (Bellon et al. 2011).
	Water stress and scarcity	• Glaciers and ice caps melts continue to affect water catchment downstream leading to water stress and scarcity. Example: glacial retreat of Mount Kilimanjaro is expected to bring acute problem of water scarcity particularly in the arid and semi-Arid regions of Africa (Kumssa and Jones 2011). • Severe drought events exacerbate water scarcity (Pitman et al. 2011). • Insecurity of water supply associated with climate change threatens the achievement of Millennium Development Goals to reduce the number people without sustainable access to safe drinking water (Hadipuro 2007).	
	Destruction of homes and properties	• Floods and related climate shocks destroy shelter and properties and curtail one's ability to meet basic needs. • Examples: Fijian flood (2009) brought economic losses of F$24 million affecting at least 25% of farm households (Lal 2010). • Sea level rise and increased frequency of extreme events put increase the risk of loss of lives, homes, and properties and damages infrastructure and transport systems (Adrianto and Matsuda, 2002; Suarez et al. 2005; Philips and Jones 2006; Ashton et al. 2008; Von Storch et al. 2008).	• In the Netherlands, the total amount of urban area that can potentially be flooded from has increased six-fold during the 20th century and may double again during the 21st century (de Moel et al., 2011).

Erosion of livelihood assets and human capabilities	**Livelihood assets**	• Tanzania, agricultural households faced with droughts engage in environmentally destructive activities (reducing fallows, engage in charcoal and timber production) (Paavola 2008) • Household assets such as livestock may be disposed in times of crop failures (1999/2000 drought in Ethiopia) (Carter et al. 2007); livelihood and livestock numbers of kuchi pastoralists where reduced to pre-war levels in Afghanistan due to the 1999-2004 drought (de Weijer 2007).	• In England and Wales, changes in flood risk project up to 20-fold increase in economic risk by 2080s (Hall et al. 2003).
	Human capital	• Health: Lancet Commission (Costello et al. 2009): - food shortage, absence of safe and reliable access to clean water and good sanitary conditions, and destruction of shelters and displacements, all have negative bearing on human health - poor nutrition combined with mental health conditions after a disaster can lead in the long run to erosion of human capability	• Health: A comparative analysis of African and non-African counties using an 'income-climate trap model' that explains the multi-directional interaction between income, climate and life expectancy, reveals that climate is important in determining both life expectancy and income. • Climate change likely to worsen localised conditions that could see many less developed countries, particularly those from Africa, sinking deeper into an income-climate trap of underdevelopment in health (Tang et al. 2009). • Analysis of the economic and climatic impacts of three emission scenarios targeting 550 ppmv atmospheric concentration and three tax scenarios, estimates the impacts on food productivity and malaria infection to be very severe in some Asian countries (Kainuma et al. 2004).
		Education: Droughts and floods can intensify the pressure to transfer children to the labour market (Ethiopia and Malawi, UNDP 2007). - Indian women born during a drought or flood in the 1970s were 19 percent less likely to ever attend primary school, when compared with women of the same age who were not affected by natural disasters (UNDP 2007).	• Loss of lives: Studies of the impacts of future floods using a combination of socio-economic and climate change scenarios for developed countries predict an increase in fatalities. Example: In the Netherlands, sea level rise combined with other factors potentially increases the number of fatalities four times (Maaskant et al. 2009)

Table 12-2: Cultural dimensions of human security in the context of climate change.

Core climate change dimensions	**Cultural dimensions**	**Role in shaping HS (facilitating - hindering adaptation, action, response)**	**References**
An English language phenomenon – not easily understood in all languages and cultures English a dominant language, Scientific uncertainty about rate and magnitude of change	Translation and incorporation of terms and uncertainty Fusion of nature and culture a cross-cultural feature Availability of explanatory tools	Importation of concepts will most likely hinder adaptation, but in some cases facilitating adaptation	Rudiak-Gould 2012, Roncoli, et al, Strauss and Orlove 2003: 3-4 2006; Kuruppu and Liverman, 2011;
Changing climate; changing natural resource base; changing access to resources and places	Flexibility Knowledge Cosmology World views Narratives and history about past changes and current conditions Heterogeneity within groups	New technology Livelihood diversification Limitations of local knowledge, Perceptions of resilience -Successful translation Level of trust in science	Adger *et al*., in review, Hovelsrud et al 2010, West and Hovelsrud; Kuruppu and Liverman 2011, Rudiak-Gould 2011; 2012; Roncoli et al 2011; Gearheard *et al*., 2010; Hovelsrud and Smit, 2010; Nyong *et al*., 2007; Tyler *et al*., 2007; Angassa and Oba, 2008; Desta and Coppock, 2004; Ford *et al*., 2008; Osbahr *et al*., 2010; Lefale, 2010
New and changing environmental and climatic conditions creating risks (floods, drought, diminishing sea ice)	Erosion of cultural core, worldviews, and knowledge; Limitations for responding (change beyond cultural repertoire Power relations; Constrain action	Institutional response will determine how HS is affected Role of resource management Awareness of culture Knowledge applicability Lack of awareness and understanding hinder adaptation	Crate, 2008; Gregory and Trousdale, 2009; Davidson *et al*., 2003; Harries and Penning-Rowsell, 2011; Gero *et al*., 2011; Fazey *et al*., 2010; Furgal and Seguin, 2006; Sudmeier-Riuex *et al.,* 2012; Anik and Khan, 2012; Ford *et al.,* 2006); Kuhlicke, 2010; Valdivia *et al*., 2010; Kesavan and Swaminathan, 2006
Local observations of change in climate and environmental conditions	Long term and historical observations and experience Intergenerational transfer	Integration of local and scientific knowledge will facilitate adaptation Climate projections with local relevance Inclusion in policy and decision making decreases risk	Anderson *et al*., 2007; Frazier *et al*., 2010; Marfai *et al*., 2008; Vogel *et al*., 2007; Kalanda-Joshua et al., 2011; Flint *et al*., 2011; Ravera *et a.,l* 2011; Smit et al 2010; Ifejika Speranza *et al*., 2008; Ingram *et al*., 2002; Alcántara-Ayala, 2004

Table 12-3: Empirical evidence on observed or projected mobility outcomes (migration, immobility, or displacement) associated with weather-related extremes or impacts of longer-term climate change. Note that direct causality is difficult to detect or infer in many studies.

	Evidence for increased migration, mobility or increased displacement	Evidence for decreased migration, mobility or significant trapped populations	Evidence for socially-differentiated mobility outcomes
Drought and land degradation	Mexico: Increased propensity to migrate to the United States related to years with negative crop productivity (Feng, Krueger et al. 2010) Ethiopia: Outmigration of household heads due to drought related famine, although coping strategies employed create variation in when migration takes place (Meze-Hausken 2000). Western Sahara: Droughts play a crucial role in patterns of international migration from refugee camps (Gila, Zaratiegui et al. 2011). Sahel: In three case regions, the pressure to migrate significantly increased since the 1970s possibly as a response to the onset of the persistent droughts. (Scheffran et al., 2012). Canada: Higher population loss associated with settlements containing areas of poorer quality agricultural soils during droughts of 1930s (McLeman and Ploeger 2011). Kenya: Households farming high quality soil are less likely to migrate, especially temporary labour migration (Gray 2011). Burkina Faso: Simulations of dry climate scenario produces increased migration fluxes compared to wet scenarios. Highest international migrant flows are shown with the dry climate scenarios (Kniveton et al. 2011) India: Temporary migration identified as 'the most important' coping strategy in times of drought in rural villages (Jülich 2011)	Mali: Reduced international migration during 1980s drought and an increase in cyclical migration (Findley 1994). Nepal: Deforestation, population pressure and agricultural decline leads to local mobility, especially among women, but no increases in internal or international migration (Massey, Axinn et al. 2010; Bohra-Mishra and Massey 2011) Uganda: Soil quality is positively associated with increased migration, especially permanent non-labor migration (Gray 2011).	Ethiopia: Male migration increases with drought. However, marriage related moves by women decrease with drought. (Grey and Mueller, 2012) United States : Dustbowl migrants from Oklahoma to California in the 1930s had different social and economic capital endowments to those who stayed within state (McLeman and Smit 2006). Ecuador: Influence of natural capital on migration differed between men and women. Access to land facilitates migration in men; women are less likely to migrate from environmentally degraded areas (Gray 2010). Mali: Land degradation is associated with less first time migration, but more migration for previous migrants. Land degradation greater influence on migration than rainfall variability (Henry, Piché et al. 2004). Mali: Drier region populations more likely to migrate than people from regions with more rainfall. Rainfall deficits have different impacts depending on the duration and distance of the migration (Henry, Schoumaker et al. 2004). Mongolia: Diversity in herders' mobility strategies to mobility in response to climate change. For a minority, responses entailed greater overall annual mobility. Other herding households experienced significant reductions in mobility Upton (2012).

Coastal storms and floods	Vietnam: Cumulative impacts of seasonal flooding increases outmigration rates in the Mekong Delta (Dun 2011) USA: counties and parishes in Louisiana of the 77 impacted counties experienced 82% of the total population increase in the year following Hurricane Katrina (Frey and Singer 2006). Bangladesh: 22% of households affected by tidal-surge floods, and 16% affected by riverbank erosion, moved to urban areas. Penning-Rowsell et al. (2012)	Senegal: Over 40 percent of new migrant populations located in high risk flood zones in Dakar (Quoted in Black, Adger et al. 2011) Bangladesh: No out-migration detected after 2004 tornado in Bangladesh as a result of the effective distribution of disaster aid (Paul 2005)	USA: Emergency evacuation responses and return migration after the event highly differentiated income, race, class and ethnicity (Elliott and Pais 2006; Falk et al. 2006; Landry et al. 2007). Bangladesh: Wide variation among groups in attitudes and capabilities for migration as an adaptation to the impact of cyclone Aila (Kartiki 2011).
Sea level rise	Vanuatu: Whole village displacement associated with inundation, both from sea level rise and tectonic movement on Torres Islands (Ballu, Bouin et al.) United States: The impact of future sea-level rise will extend beyond the inundated counties through migration networks that link inland and coastal areas and their populations (Curtis and Schneider, 2011) United States: Underlying driver of sea level rise caused initial depopulation. Final abandonment was a result of the population falling below levels to support local community services. (Arenstam and Nicholls 2006) Papua New Guinea: Population considering resettlement on Bougainville to the main island due to coastal erosion, land loss, saltwater inundation and food insecurity (Oliver-Smith 2011) United States: Coastal villages in Alaska affected by sea-level rise and coastal erosion. The population as Shishmaref have decided to relocate (Oliver-Smith 2011; Marino, 2012).	Tuvalu: On the island of Funafuti, climate change is not a cause for concern nor cited as a reason for migration (Mortreux and Barnett 2009)	

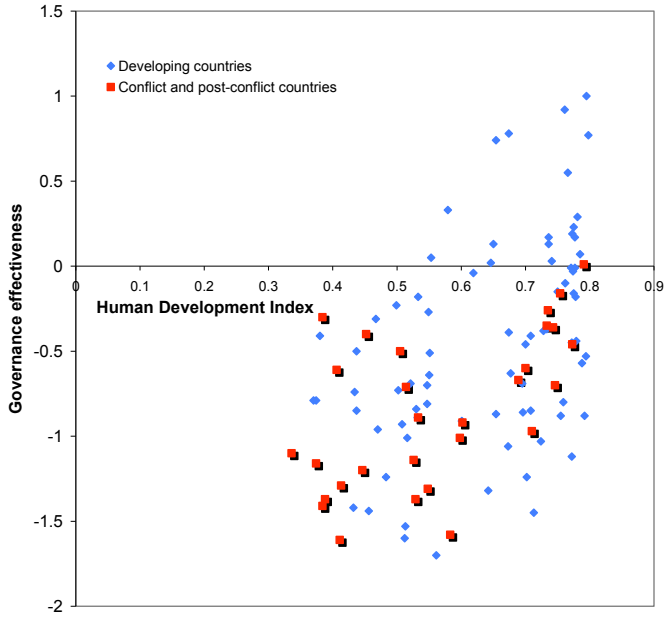

Figure 12-1: Conflict and post-conflict societies exhibit low levels of governance and human development. Source: Adger (2010).

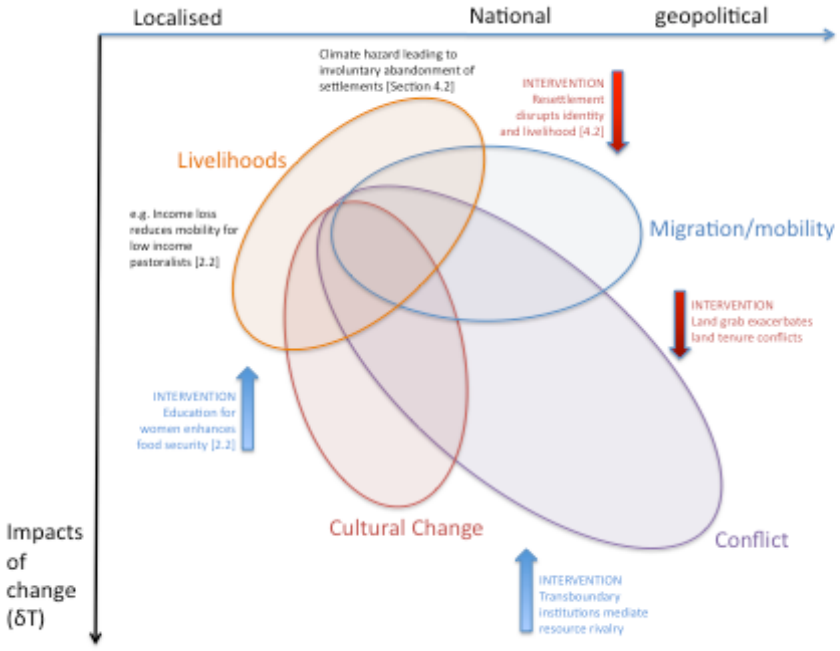

Figure 12-2: Synthesis of evidence on the impacts of climate change on elements of human security and the interactions between elements.