Chapter 12. Human Security

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Executive Summary

Key elements of human security, such as the life and livelihood of vulnerable populations, are threatened by the impacts of climate change. Vulnerability is particularly concentrated in socially and geographically marginalized populations. Observational evidence as well as those from projections indicates that climate-related risks associated with droughts, floods, storms, and other events have the potential to disrupt people's lives, leading to deprivation of basic needs and erosion of livelihood assets and human capabilities. A combination of changes in frequency and intensity of weather-related hazards as well as the combined effects of a confluence of large scale environmental, socio-economic, political, and technological changes felt at various scales reinforce each other, exacerbating vulnerability in many parts of the world and contributing to human insecurity. There is much evidence for the effectiveness of adaptation strategies for insecure populations that involve securing property rights, diversifying incomes and mobility.

Climate change has significant cultural implications that affect the viability of communities, and places and natural and cultural heritage of symbolic importance and cultural expression. For many resource dependent societies and indigenous peoples, culture is constructed around livelihood activities such as pastoralism, herding, farming, small scale and artisanal fishing, rural activities, nomadism, and hunting and gathering. 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. Culture shapes adaptive and maladaptive responses, which may not seem rational through other cultural lenses. In order to understand human security it is therefore imperative to understand how the cultural particularities shape such responses. Building capacity, strengthen institutions and ensuring participation reduce risks in communities and enhance human security.

Indigenous peoples are resilient, but live in areas and depend on resources that are highly sensitive to climate change impacts. Indigenous and traditional knowledge is a major resource for dealing with the risks of climate change. How indigenous peoples are included in decision-making, policy developments, assessments and training have consequences for their human security. Although traditional practices are highly dynamic and indigenous peoples are participants in a globalized world they are at risk when their voices are not heard, when policies and institutions encroach upon, and creates barriers and constraints on their livelihoods and lifestyles. Language retention, indigenous knowledge transfer and youth retention are important factor for ensuring human security among indigenous peoples.

Local and traditional knowledge is deeply rooted in history, reflects and reasserts values, and is invaluable for adapting to changing conditions and for evaluating policy responses. Local and traditional knowledge has an important role to play in disaster management and risk mitigation but is often neglected with serious consequences for human security. Erosion of local and traditional knowledge occurs through interrupted knowledge transfer between generations, and with significantly changing socio-economic and environmental conditions. Integration of local and scientific knowledge will benefit both, and provide broader understanding of risks.

Impacts of climate change affects mobility and migration, increasing rates and decreasing rates in specific circumstances. There are two offsetting trends. 1) Loss of agricultural productivity and coastal inundation increases likely displacement under all scenarios of future climate change. Most displacement associated with climate change impacts will be internal within countries, but international migration is important in small countries and for well-established historical migration flows. 2) 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.

Migration is a major adaptation strategy to enhance human security to climate change impacts. The greatest challenge for migration-related adaptation is in making the resulting urbanization more sustainable. To realize the benefits of increased mobility, the governance and policy literature converges on the desirability of new international governance mechanisms.

Although there is evidence of historical coincidence of violent conflict with resource scarcity, there is no evidence that shared water resources and scarcity leads to violent conflict between states.

Resource scarcity induced by climate change impacts may perpetuate violent conflict in regions where it is pervasive. Post conflict states are vulnerable to the impacts of climate change because of low human security or the capacity of the state to effectively deal with risks.

Climate change impacts will contribute to inter-state rivalry over shared resources, such as the Arctic, but there is no evidence that such rivalry exacerbates the likelihood of violent conflict between states.

12.1. Scope of Human Security Approach

12.1.1. The Scope and Definitions of Human Security

Human security encompasses the ability of people to have and to maintain, well-being, heath, a clean environment and an absence of imposed violence and hazard. Human security in the context of climate change also encompasses the presence of options and freedom to be safe and to adapt to imposed harm. The literature on human security has diverse definitions, but all converge on the ideas that human security relates to the well-being of individuals and communities beyond the security of the state (Gasper, 2005; Barnett, 2011). The impacts of climate change on human security are therefore on: material well-being and basic needs; on cultural impacts of climate change including on indigenous peoples and knowledge; on migration and mobility; and on climate change interactions with conflict. The contribution of this Chapter is to examine all the elements and interactions between human wellbeing and climate change risks.

Human security was proposed by UNDP (1994: 3) as a people-centred security concept, where "security … means safety from the constant threat of hunger, disease, crime and repression" as well as "protection from sudden and hurtful disruption in the pattern of our daily lives". For this chapter human security encompasses impacts of climate change as a set of risks to the needs of people to live, as a set of risks to material and non-material social phenomena that people value, and as a set of risks to fundamental rights for example to continue residing in places without displacement.

The Commission on Human Security (CHS 2003) referred to human security as 'freedom from want' and 'freedom from fear', where human security "complements state security, enhances human rights and strengthens human development". Kofi Annan (2005) added 'freedom to live in dignity' focused on a) development, b) peace and collective security, c) human rights and the rule of law and d) strengthening of the UN. Most human security definitions and the UN-focused human security debate lacked references to environmental issues, and to challenges posed by global climate change. A significant body of literature suggests adding an explicit environmental dimension to human security including freedom from the impacts of natural hazards (Brauch 2008) and the capacity and freedom to undertake adaptation to imposed change (Barnett 2001; Matthew et al. 2010; Dalby, 2009).

While the international security debates addressed climate change as a 'threat multiplier', the national security debate on climate change has addressed only security threats for national security and on how to respond to be able to cope with this threat. This Chapter therefore examines issues of geo-political stability and state security inasmuch as they relate to human security and its scope includes how human beings, states and the international community can cope proactively to avoid major human catastrophes. Given this socio-political context, a scientific human security approach addresses objective, subjective and intersubjective security questions in an interdisciplinary research setting on complex interactions within and between the earth and human systems, its effects (as environmental stress), its impacts (as climate-induced hazards), and its societal outcomes such as migration, crisis, conflicts and their prevention.

12.1.2. Relationship to Other Sectors and Scales of Security

From a human security perspective climate change directly impacts on other sectoral concepts, such as water, soil, food, health and livelihood security. The linkages between nature and society depend on healthy ecosystem services (Millennium Ecosystem Assessment, 2005). In its *provisioning* functions they offer freshwater, air, food, wood, fuel and fibre and they *regulate* the climate, purify water and air, control floods and storms; in its *supporting* functions they offer the nutrients and waste management for the soil, disintegrating, processing and detoxifying hazardous components and finally, guarantee *cultural heritage* and non-material benefits for recreation. This complexity influences the material minimum for human and ecosystem survival, social relations, freedom and choice, as elements of human security. Other Chapters in this report examine specific risks and security implications of food, water and health. In this chapter we examine the interactions of material and cultural impacts of climate change to these other major aspects of human security:

1) Water security refers to "water resources and the related ecosystems that provide and sustain the vital liquid [that] are under threat from pollution, unsustainable use, land-use changes, climate change and many other forces… ensuring that freshwater, coastal and related ecosystems are protected and improved; that sustainable development and political stability are promoted, that every person has access to enough safe water at an affordable cost to lead a healthy and productive life and that the vulnerable are protected from the risks of water-related hazards." (Second World Water Forum in The Hague 2000).
2) Food security is understood as "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO 2003). Via Campesina referred to food sovereignty as "the right of peoples, communities, and countries to define their own agricultural, labour, fishing, food and land policies, which are ecologically, socially, economically and culturally appropriate to their unique circumstances. It includes the true right to food and to produce food, which means that all people have the right to safe, nutritious and culturally appropriate food and to food producing resources and the ability to sustain themselves and their societies" (Food Sovereignty: A Right For All, Political Statement of the NGO/CSO Forum for Food Sovereignty, Rome, June 2002).
3) Individual well-being is related directly to health status and risks to individuals and populations. While the World Health Organization (WHO 2002) uses a state-centred understanding of health security related to epidemics, bioterrorism and prevention while other perspectives emphasise the threats of ill health to communities and individuals (Leaning 2009) and on the interrelationship between human health, water, nutrition and environmental services as important health providers (e.g. Cortes and Calderón 2011).

Human security has been widely discussed as a normative concept in the context of present global inequality and of lack of development. Human security also relates to universal approaches such as rights (see Box 12-1).

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Box 12-1. The Relationship between Human Rights, Human Security, and Climate Change
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It will review the scientific literature on three related issues;

1) Research on whether observed and future climate change impacts breach existing human rights as practiced and recognized in international law.
2) Theoretical research concerning what rights are defensible to be attached to persons subject to climate change (Humphreys, 2010). Caney (2010), for example, suggests three human rights related to the impacts of climate change on individuals: 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 be forcibly moved. Others consider rights of non-humans as part of a set related to climate change impacts.
3) What are the existing and projected legal issues around the practicality of human rights in policy, litigation and compensation related to impacts and insecurity? This will review legal scholarship that has led to test cases, but also arguments that rights may not be useful in climate policy (e.g. Adelman, 2010; Depledge and Carlane, 2007).

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12.1.3. Nature of Evidence, Confidence, and Causality in Field of Human Security

The literature on human security recognizes the contested and normative nature of the concepts of well-being, rights and values. To date there have been relatively few studies directly on the overall impact of climate change on human security. In this Chapter we assess the scientific evidence base that addresses: a) individual elements of health, conflict, basic needs and socially and geographically marginalized populations through analogies of climate change impacts, observational studies and projections to the future; and b) synthesis studies that examine interactions between elements of human security in the context of climate-related risks.

The analysis of human security in this Chapter recognizes the cascading effects of uncertainty in the synthesis of evidence from diverse disciplines and methodological approaches. Uncertainties in the measurements and modeling of climate change are amplified when projecting their effects on the ecosystems and biological resources upon which people rely. Further amplification of uncertainty results when assessing the consequences of such changes upon the human security of communities (van Oort et al in press).

Human security is also affected by multiple interacting stresses. The elements of well-being, rights and values are affected by a complex set of interacting societal and environmental factors or stressors. Studies show that climate change alone may not necessarily be the most salient factor that drives human security, but that it has critical linkages to changing and challenging socio-economic and political conditions. In many cases climate change may exacerbate risks and stresses in an already tenuous societal situation often related to natural resource use and well-being, and create challenges beyond current adaptive capacity, with subsequent consequences for human security. A distinction may be made between social, political and economic conditions without a climate change link, and those with more direct links. The latter includes traditional livelihood activities under stress, lack of infrastructure for provision of adequate goods and services, land use disputes, a shifting natural resource base and cultural mismatch between local resource users and policy makers (Hovelsrud et al., 2010).

To date, a diverse range of scientific disciplines and approaches have addressed human security and climate change linkages including policy-focused scenario research; discourse analyses; and qualitative and quantitative empirical causal analyses (Lee 2009; Nordås and Gleditsch, 2007). Many of these studies point to the limits of causal pathways of the physical effects of climate change and its extreme societal outcomes on human security (Scheffran et al. 2011).

The German Advisory Council on Global Change (WBGU, 2008) discussed four possible conflict constellations as to how climate change could trigger international security consequences: 1) climate-induced degradation of freshwater resources, 2) climate-induced decline in food production, 3) climate-induced increase in storm and flood disasters, and 4) environmentally induced migration “as a driver of social destabilization and threat to international security” with the dual goal of “understanding the climate-security nexus” and developing “policies to prevent and contain conflict”, especially regarding conflict constellations.

From a policy perspective, the report of the UN Secretary General (2009: 7) pointed to five pathways linking climate change and international security (vulnerability, development, coping, statelessness, international conflict) and suggested sustainable development (adaptation, economic development, governance, capacity building, mitigation, conflict prevention) as a threat minimizer.

Climate change will have unpredictable effects on the earth and human system with negative loops and feedbacks. This new and highly complex situation is further complicated by state fragility. The combination of these factors has already created a high level of uncertainty for studies in the realm of human security and climate change.

Different approaches, methods and scientific disciplines will provide different forms of evidence of human security. In analyzing human security we need to pay attention to the approach of the researchers, whether it is top-down or bottom-up, whether it is multi-scalar or a single focus, and how it addresses the linkages between multiple factors and stressors. The research questions we pose drive our methods and thereby the results and evidence.

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

12.2.1. Basic Needs and Livelihoods

12.2.1.1. State of Knowledge within Human Security Literature

This section reviews the evidence on how human security may be affected by climate change impacts through risks to the basic needs for life and livelihood. The evidence base is extensive on impacts on the underlying components

of human security. 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).

Analytically, issues of basic needs have been subsumed into discussions of sustainable livelihoods (e.g. Chamber and Conway 1992: 7-8). Livelihoods are sustained through using a mix of five kinds of capital, namely: natural capital (such as soils, water resources, and plants and animals); physical capital (infrastructure such as roads, power supply systems, buildings, and water supply systems); human capital (such as knowledge, skills, and ability to work); social capital (such as membership of groups, and networks of institutions); and financial capital (such as credit, savings, and transfers) (Scoones 1998, Pretty and Hine 2000, Talossa 2008). (Reducing dependence on natural capital reduces the risk climate change poses to the livelihoods of resource dependent households (Badjeck et al. 2010). Social capital can reduce vulnerability by enabling the sharing of ideas, equipment, money, and of labor in times of crisis (Perry and Sumaila 2007). Financial capital, such as through access to credit, can facilitate investments in diversification of income streams, or in intensification of production as means to manage climate change (Bryan et al. 2009).

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 cut one's 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 (see for instance, O'Brien and Leichenko 2007; UNDP 2007; O'Brien et al. 2008; Adger 2010; Kumssa and Jones 2011). Examined from the two major pillars of human-centered view of security in the climate change arena, insecurity in terms of "want may come from resource scarcity caused by changing water availability or productivity of the land and the fear may come from risks to health or one's place of residence" (Adger 2010:281). Both the fear and want pillars are at the core of the basic needs and livelihoods dimensions of human security.

12.2.1.2. Observational Evidence

Much of the literature that examines the impacts of climate change on basic needs in the context of human security may be subsumed into three main categories: 1) agriculture and food security, 2) water stress and scarcity, and 3) destruction of homes and properties. Viewed from the perspective of human security, observational evidence indicates that climate-related risks associated with droughts, floods, storms, and other events have the potential to disrupt people's lives, leading to deprivation of basic needs and erosion of livelihood assets and human capabilities.

Deprivation of immediate basic needs

- Agriculture and food security. Climate change, as it interacts 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). Majority of the studies have focused in Africa, viewed as the most vulnerable region of the world, due to its over-dependence on rain-fed agriculture (Kumssa and Jones 2011). In Kenya, climate change and poverty contribute to food insecurity with the health of the farmer and her experience emerging as important in the fight against food insecurity (Oluoko-Odingo 2011). Similarly, the combined impacts of drought, unemployment and inflation brought about food insecurity in low income urban households in

Zimbabwe. Interaction between AIDS epidemic and climate change also impacts on food security in Southern Africa (Dremie and Gillespie 2010).

- Water stress and scarcity. Glaciers and ice caps melts have continue to affect water catchment downstream leading to water stress and scarcity for agriculture, human settlement, and the energy sector. The observed dramatic glacial retreat of Mount Kilimanjaro is expected to bring acute problem of water scarcity particularly in the arid and semi-Arid regions of Africa which depends on the run-off from the melting glaciers for water (Kumssa and Jones 2011). Severe drought events also exacerbate water scarcity depriving many households access to this basic commodity (Pitman et al. 2011). Insecurity of water supply associated with climate change threatens the achievement of Millennium Development Goals to reduce by half the number of 1.1 billion people without sustainable access to safe drinking water by 2015 (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. The 2009 Fijian flood for instance, brought economic losses of F$24 million in the country's sugar belt, with at least 25% of the affected farm households unable to meet their basic needs. Studies on coastal areas indicate that sea level rise and increased frequency of extreme events like storm surges put human population at risks in terms of loss of lives, homes, and properties and damages to infrastructure and transportation (Adrianto and Matsuda, 2002; Suarez et al. 2005; Philips and Jones 2006; Ashton et al 2008; Von Storch et al. 2008).

Few literatures argue, however, that perception of vulnerability and human security may be shaped by cultural values, perceptions, and meanings (Kuruppu 2009; Van de Vliert 2007), not necessarily by observational evidence. A study of the charlands of the Damodar River in India demonstrates that despite the vulnerability of the area to flooding and river bank erosion, migrant communities continue to settle there because the soils are fertile and lands are cheap (Lahiri-Dutt and Samanta 2007).

Erosion of livelihood assets and human capabilities

Climate shocks are also observed to erode livelihood assets and human capabilities. When faced with droughts, agricultural households in Morogoro, Tanzania are forced to engage in environmentally destructive activities such as reducing fallows and engaging in charcoal and timber production that deplete and degrade the natural assets (Paavola 2008). Household assets such as livestock which provide productive resource, nutrition, collateral for credit, and source of income to meet health and nutrition costs, may be disposed in times of crop failures, such as during the 1999/2000 drought in Ethiopia, contributing to household's livelihood insecurity (Carter et al. 2007). Similarly, the 1999-2004 drought in Afghanistan severely affected the kuchi pastoralists, with their livelihood and livestock numbers plummeting to the pre-war level in the northern part (de Weijer 2007).

Human capital and capabilities can be eroded by climate-related phenomena. A growing body of livelihoods literature indicates that droughts, floods, storms, and other climate events disrupt production, cut income, reduce spending, or alter common practices of housesholds which affect their financial situation, nutrition and health, as well as deprived children of education opportunities (see for instance, Leary et al. 2008; Peras et al. 2009; Tang et al. 2009). Findings of the Lancet Commissions on the impacts of climate change on health show that 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 (Costello et al. 2009). The same report suggests that combined with poor nutrition, mental health conditions after a disaster, such as depression and anxiety can lead in the long run to erosion of human capability.

Similarly, climate shocks impacts on the education of the poor households which can be a major source of human capability erosion. Droughts and floods can intensify the pressures of poor households being forced to transferring children from classrooms into labour market such as in Ethiopia and Malawi (UNDP 2007). Moreover, an econometric model developed to track the impacts of climate shocks across time indicates that 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).

Just like the basic needs literature, there is full agreement on the livelihood literature that livelihood insecurity is multi-dimensional and multi-scalar in nature where climate change serves as a major stressor. Some authors have used the sustainable livelihood framework (with some variations) as a useful tool to examine the complexity of livelihoods in the context of climate change and human security (see for instance, Ziervogel and Calder 2003; Tolossa 2008; Badjeck et al. 2010).

12.2.1.3. Evidence from Projections

Most scientific literature using methods that project future impacts that relate to the potential impacts of climate change on basic needs and livelihoods centered on agriculture and food security, health, and flood risks. Several impact studies conducted in African agriculture using various climate scenarios are in agreement 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. Economic impact assessment on crop production in Ethiopia (Deressa and Hassan 2009) and livestock production in Kenya (Kobubo-Mariara 2009) both using the Ricardian model and various climate scenarios, indicate that farmers are likely to incur heavy losses from global warming. A study on the marginal impacts of unit changes in temperatures and precipitation on crop farming activities of 4,000 farms in Burkina Faso, Egypt, Kenya and South Africa using selected scenarios for 2050 and 2100, suggests that global warming is harmful for agriculture across all the countries (Molua et al. 2010). Moreover, a study by Jones and Thornton (2009) using downscaled climate model indicates the possibility of livelihood transition in 2050 in some parts of sub-Saharan Africa from croppers to livestock keepers due to increased probabilities of failed seasons and likely severe impacts of climate change in the marginal cropping lands where poverty rates are already high.

In health-related studies, 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 is also 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).

A number studies, all from developed countries, analyzed the likely impacts of future floods on lives and properties using a combination of socio-economic and climate change scenarios. A study by Maaskant et al. (2009) involving the analysis of flood-prone areas in The Netherlands using high economic growth scenario and loss of life model reveals that a sea level rise of 0.30 m potentially leads to an average of 20% increase in number of fatalities; combined impact of sea level rise and population growth leads to an estimated doubling in the potential number of fatalities; and increasing probability of flooding due to sea level rise and extreme river discharges could quadruple the expected number of fatalities. A similar study, also in Netherlands, shows that the total amount of urban area that can potentially be inundated due to floods from the sea or main rivers has increased six-fold during the 20th century and may double again during the 21st century (de Moel et al., 2011). The same study reveals that the potential flood damage has increased exponentially by 16 times over the 20th century and is expected to rise exponentially by a 10-fold by 2100 (with respect to 2000) assuming a high growth economic scenario. A quantified scenarios of drivers and impacts of changing flood risk in England and Wales projected up to 20-fold increase in economic risk by 2080s in the scenario with highest economic growth attributable to climate change and increasing socio-economic vulnerability, particularly in terms of household and industrial contents and infrastructure vulnerability (Hall et al. 2003).

12.2.1.4 Synthesis: Social Change, Climate Change, and Human Insecurity

Vulnerability to disasters are increasing, due to a combination of changes in frequency and intensity of weather-related hazards as well as the combined effects of a confluence of large scale environmental, socio-economic, political, and technological changes (O'Brien et al. 2008). The adverse effects of social change and climate change

felt at various scales reinforce each other, exacerbating vulnerability in many parts of the world and contributing to human insecurity (Pitman et al. 2011; McNeeley and Shulski 2011; Osbahr et al., 2008; Eakin 2005; Eakin et al. 2010; Bunce et al., 2010). Addressing this complex mix of multiple stressors at various scales poses a major challenge in terms of the provision of basic needs and livelihoods as the first line of defense against human insecurity amidst the compounding threats from climate disasters. A complimentary challenge is the need to shift from a disaster focused view of climate to a long-term perspective that emphasizes livelihood security and vulnerability reduction (Conway and Shipper 2011).

12.2.2. Socially and Geographically Marginalized Populations

12.2.2.1. State of Knowledge within Human Security Literature

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). This section reviews the evidence on how social and geographical marginalisation within society interacts with climate risks, 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 indigenous people are the 'poorest among the poor' and most vulnerable (Polack 2008; IPCC 2007). People living in particularly vulnerable regions that will be most affected by climate change (populations in coastal and low-lying areas; in mountain and polar regions; and some urban and rural populations), will also be highly affected (IPCC 2007). Climate change will have an impact on the basic needs and livelihoods of these populations threatening human security.

12.2.2.2. Observational Evidence

Gender

Women in developing countries constitute one of the poorest and most disadvantageous groups in society in most regions (Mitchell et al. 2007; Denton 2002). This partly reflects decisions taken within the household, which typically favour males over females, for complex and context-specific reasons. In many regions of the world, women have less access to financial resources, land, education, health and other basic rights than men, and are also seldom involved in decision making processes (Mitchell et al. 2007; Demetriades and Esplen 2008). These make women less able to cope with the impacts of climate change and less able to adapt to it (Demetriades and Esplen, 2008).

Research shows how poor women in developing countries such as Bangladesh, India and Nepal are struggling to protect their lives, homes, assets and livelihoods from weather related hazards (Mitchell et al. 2007). Social differences shape women's vulnerability (Terry 2009): women's vulnerability to natural hazards in India arises from poverty and marginalization, not simply the physical effects of the hazards themselves (Fajber 2009; Roy and Venema 2002). Similar evidence is found in Mexico (Buechler 2009) and Peru (Rivero 2002).

Evidence of the interlinkages between gender inequalities, poverty, differential capacity of women and men to adapt or reduce risks is often drawn from more generic evidence on gender aspects of poverty and development (Demetriades and Esplen 2008; Polack 2008):

- *Health:* gender discrimination in the allocation of household resources (including access to medicines and visits to medical centres) may put women and girls at greater risk than men (and boys) (Demetriades and Esplen 2008).
- *Agriculture:* women are actively involved in agricultural activities (Denton 2002). Because of this, land is their most important asset. However, it is widely recognized that women face restrictions to property and

land rights (Demetriades and Esplen 2008). This hinders their access to credit and to agricultural extension services and technologies (Brody et al. 2008; Demetriades and Esplen 2008). Research suggests that in Africa, women receive less that 10% of the credit granted to small farmers (Randriamar 2006).

- *Labour:* there is a gender gap in earnings, both for the formal and informal sectors (Brody et al. 2008). 60% of women in the developing world are in informal employment outside agriculture (Kabeer 2008) which is often hit by weather-related disasters and other shocks (Araujo et al. 2007; Brody et al. 2008; Buechler 2009).
- *Other impacts*: socially ascribed gender responsibilities such as childcare, taking care of the sick, carrying out domestic tasks including the collection of water and firewood (Araujo et al. 2007) will be affected by climate change and will therefore have an impact on women's daily lives (Brody et at. 2008; Denton 2002). Women are also affected by climate change related conflict and gender based violence and by their vulnerability to disaster situations (Brody et al. 2008; Demetriades and Esplen 2008). Women are 14 times more likely to die than men during disasters (Araujo et al. 2007). In addition, women are absent from decision-making processes regarding climate change (Demetriades and Esplen 2008; Denton 2002).

Children

While there are defensible hypotheses concerning the impact of weather-related hazards on children, there is little specific evidence about the implications for children, primarily because there is little disaggregation of data by age on observed events (CCC 2008; Save the Children 2007; Seballos et al. 2011). The evidence base, as with gender, relies on deduction from underlying literature on environmental health; the impacts of disasters; household coping strategies; and children and urban poverty (Bartlett 2008). However, advocacy literature identifies children as those who will bear the greatest burden of climate change impacts (UNICEF 2008; Save the Children 2007; Waterson 2006), especially when exposure to hazards are correlated with poverty.

Children are particularly vulnerable to the effects of climate change and climate-related disasters (Seballos et al. 2011) because they are less well equipped to deal with deprivation and stress due to their particular physical, social and psychological characteristics (Bunyavanich et al. 2003; Bartlett 2008; Cutter 1995, Peek 2008; UNICEF 2007). Despite the numerous impacts and outcomes of climate change, the same few outcomes for children show repeatedly. These will all affect children's vulnerability in terms of the intergenerational transfer of poverty; the potential impact on future's children employment; chances of migration; being involved in conflict; experiencing extreme climatic events (Polack 2008). There is increasing scientific evidence that malnutrition, disease (malaria, diarrhoea), death and injury, are highly sensitive to climatic conditions and are expected to worsen as a result of climate change (UNICEF 2008; Bartlett 2008). 25% of human deaths can be attributed to environmental factors. Among children, however this rises to 36% (Prüss-Üstün 2006).

Elderly populations

Climate change will increase the frequency, intensity and duration of heat waves and cold spells in many regions of the world. Epidemiological research has shown that older people are among those most vulnerable to the impacts of extreme weather (both hot and cold) (Aylin et al. 2001; Sheth et al. 1999; Wilkinson et al. 2001; Kovats and Hajat 2008). This trend has been shown in different regions of the world such as Spain (Diaz et al. 2002b), Italy (Conti et al. 2004), France (Fouiller et al. 2006); the US (Greenbur et al. 1983; Luber et al. 2006), Australia (Guest et al. 1999), Japan (Nakai et al. 1999), and Lebanon (El Zein et al. 2004).

This vulnerability is caused by both physical and social reasons that reduce people's capacity to adapt to extreme temperatures. First, older people are more likely to have pre-existing medical conditions that increase the effects of extreme temperatures, such as pulmonary and cardiovascular illnesses (Bouchama et al. 2007). Recent studies report a strong relationship between heat waves and increasing death rates among the elderly, particularly for respiratory and cardiovascular mortality (Astrom et al. 2011). In addition, some medications and mental disorders, such as dementia, may alter risk perception and protective behaviours (Astrom et al. 2011). Second, living alone, in poorer and more isolated accommodation, lack of mobility, and increased dependency increase the chances of death from

heat waves (Semenza et al. 1996), while elderly living in cared-for accommodation face different challenges, when several areas of their daily life are affected in a way that they feel disempowered (the dependence of residential home residents to nursing staff, the loss of morale and confidence associated to an increasing realisation of their physical and mental decline, and a loss of habitus, as they have to adapt to home norms) (Brown and Walker 2008).

Geographically marginalised populations

Location is an important determinant of hazardous exposure, and certain places will bear more risk than others (Hess et al. 2008). People living in particularly vulnerable regions (such as rural marginalized regions and urban dwellers; marginalized environments like degraded forests and soils; coastal areas susceptible to sea level rise, river banks susceptible to landslides and soil erosion; and small islands) are more likely to suffer harm (IPCC 2007). Geographic marginalization will exacerbate the vulnerability of these groups, often poor, with its implications to human insecurity.

In many cities, the poor live in places at higher levels of risk and lack the resources and options to modify their vulnerability. In Latin America, urbanization has taken place in areas highly prone to flooding or affected by seasonal storms, sea surges or other weather-related risks (Hardoy et al. 2009). Mombasa, a city with 38.2% of the population facing absolute poverty and 38.6% facing food poverty, extreme climatic events (floods, droughts and strong winds) happen every year (Awor et al. 2008).

Climate change impacts could have an effect on some rural populations (food insecurity, reduced water resources, flood and storm damage, loss of cropping land and increased rates of climate-sensitive health outcomes) (IPCC, 2007), which combined with insufficient government investment in infrastructure, low use of credit, insufficient subsidies to crop insurance and a lack of investment in more profitable crops reduces the community's coping capacities to climate change and triggers migration (Saldana-Zorrilla 2004). This will be particularly problematic to more vulnerable groups such as women, children and pastoralists who have limited access to employment, markets and public services (Paavola 2008). River-bank erosion has caused involuntary displacement, increasing poverty and marginalisation of the affected population, with women and children being particularly affected (Hutton and Haque2004).

Low islands are particularly vulnerable to increased climate variability and the impacts of extreme events in terms of physical and economic structure (Barnett and Adger 2003). They are also more food insecure; many people living in the Pacific islands derive their food directly from the environment (Nunn 2009).

12.2.3. Adaptation and Managing Risks

12.2.3.1. Evidence on Strategies for Securing Basic Needs and Livelihoods

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 opportunities can be enhanced through adaptation. Much of this research comes from development economics and related disciplines (Elllis, 2000; Dercon, 2004), increasingly applied to the arena of adapting to p[resent observed and future climate risks.

Diversification of income generating activities is a key strategy for maintaining livelihoods through periods of change. In agricultural systems, diversification takes the form of growing new crops or cultivars, or changing the timing of planting (Paavloa 2008). Shifting to new production systems is also a common strategy, for example when faced with restricted access to land for grazing, pastoralists take up agriculture as a means to augment livelihoods (Galvin 2009, Tolossa 2008). In fishing systems diversification can entail targeting new species or using alternative techniques (Badjeck et al. 2010, Coulthard 2008). Chigwada (2005) documents a range of activities adopted by people in Tongwe (Zimbabwe) after a series of climate extremes. Diversification can be 'pushed' as livelihoods are undermined, or 'pulled' as households seek new opportunities to sustain livelihoods or increase incomes, however, it may come at the expense of increased production achieved through specialization (Tolossa 2008).

When access to natural capital is significantly restricted, intensification of use of remaining accessible natural capital can augment livelihoods. For example, faced with social and environmental changes, farmers can apply more labour and inputs to existing crops (Gray and Kevane 2001). Key here is the ability to use new technologies and tools, which have been shown to enable adaptation to changing conditions in fisheries (Badjeck et al. 2010). In a study of Mexican smallholder farmers, Eakin (2005) demonstrates that where intensification involves increasing dependence on markets, farmers that intensify can trade risks to livelihoods from changes in natural capital to risks to livelihoods from changes in the markets to which they sell their goods, and from which they purchase inputs. Paavola (2008) shows through his study of farmers in Tanzania that intensification can result in degradation of common property resources such as forests and freshwater, which disproportionately effects those who most depend on these resources for their livelihoods. 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, either permanent, or seasonal and/or circular, is a key response of households to adapt to variable environmental conditions. It is a strategy used by fishers in Ghana (Perry and Sumaila 2007), and Peru (Badjeck et al 2009), and by pastoralists in Tanzania (Galvin 2009). The extent to which migration is an 'adaptation' in the sense of it being a choice to sustain livelihoods, rather than an unwanted but unavoidable response, is a matter of judgment best made by those involved in movement (Barnett and Webber 2010). Yet there is evidence to suggest that migration is most often an adaptation strategy more than an impact of climate change (that is to say it is more often a voluntary choice than is forced), and that this is more likely to be the case the higher the incomes of households from which people move (Galvin 2009).

Insurance, from formal markets and from informal sources, 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).

12.2.3.2. Education as a Strategy for Reducing Insecurity

Education is a key to adaptation for socially and geographically marginalized populations. It enables people to make better choices, for example about ways of farming or fishing or building; it improves access to labour markets; it improves access to financial services; and it improves access to information that enables people to manage risks (including climate information) (Badjeck et al. 2010, Doss and Morris 2001). Shah and O.G. (2009) find that literacy and employment in small scale industries are significant variables that explain the vulnerability of people in tribal areas to forest decline in Gujarat (India). Halverson (2003) finds a correlation between diarrhea in children and households where mothers have not received formal education.

12.2.3.3. Evidence on Rights and Empowerment as Strategies for Reducing Insecurity

Dramatic changes in the rights of social groups to practice livelihoods systems can undermine their ability to adapt to climate change. Tolassa (2008) shows how strategies of past governments in Ethiopia sought to transform pastoralists into sedentary farmers, which undermined their ability to practice transhumance between seasons. The transfer of common property resources to private ownership can undermine the ability of resource dependent groups to adapt to climate change, as shown by changes in land rights in Vietnam (Adger 2000), and Ethiopia (Tolassa 2008). Secure rights to use land are critical to adaptation (Eakin 2005, McSweeney and Coomes 2011)

Having the right to articulate one's own climate insecurities, and to participate in the design of responses, is itself an important right that can help to reduce vulnerability (Adger 2010). The right of social groups to mobilize to address issues of common concern is important, as such groups can: help empower otherwise marginalized people, help people to become more self-reliant, and help people to learn about risks and adaptation responses. They can also help to facilitate dialogue between communities and decision makers such that policies can be more effective (Allen

2006, Few et al. 2007, Polack 2008). Thus, community-based approaches are widely seen to empower local people in adaptation processes (Allen 2006). Yet there is some evidence that community based approaches do not always empower individuals and groups, and that they can also disempower people by reinforcing local power relations, legitimate processes that are not inclusive, ignore the effect of wider structural forces that create vulnerability, increase workloads, and heighten people's anxieties (Allen 2006, Milligan et al. 2009).

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 enable adaptation to changing environmental conditions (Galvin 2009).

12.2.3.4. Evidence on Reducing Gender Inequality on Reducing Insecurity

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). In rural areas in northern Pakistan, the ability of women to minimize the frequency of diarrhea in their children is reduced by decreased rising living costs, male off-farm employment, the breaking up of extended families, and restrictions on women's access to places, services and networks (Halvorson 2003). Thus, female empowerment increases the capacity of women to maintain child health.

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). In a study from Ghana Dross and Morris (2001) found that women less extensively adopted higher yielding and more drought and pathogen resistant varieties of maize, and that this is correlated to their smaller land holdings, fewer years of schooling, and less frequent contact with agricultural extensions officers (compared to male farmers). They conclude that agricultural adaptation activities do not benefit men and women equally, because women "do not enjoy equal access to land, education, and agricultural extension services" (Doss and Morris 2001: 37).

Studies find that female headed households fare less well during periods of environmental disturbance because of the time costs associated with domestic responsibilities, restricted mobility, and barriers to women's access to work in certain sectors such as carpentry, and to certain resources, including land and timber (Eriksen et al. 2005). Ensuring the participation of women throughout adaptation processes is critical to ensure that adaptation decisions and activities are effective and equitable (Polack 2008).

12.3. Cultural Dimensions of Human Security

Climate change clearly has cultural implications (Crate, 2008; Heyd 2008; King *et al*., 2008). Culture is expressed through material artifacts, norms, beliefs, values, practices, social relationships and networks, and perceptions of risk (Heyd, 2008; Tingley *et al*., 2010), which in turn shape both adaptive and maladaptive responses (Nielsen and Reenberg, 2010; Petheram *et al*., 2010). Assessments of the cultural dimensions of human security in the context of climate change must consider resilient, viable and sustainable communities, local involvement, indigenous issues and the role of local and traditional knowledge (Green *et al*., 2010). Attention to differences between cultural groups reveals an important level of understanding, while differences within such groups provide an even more nuanced picture of how human security is affected by the combined changes in climatic and societal conditions.

For many indigenous peoples and local communities, 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). 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). In the case of community relocation for example mythological symbols are lost (Crate, 2008).

In addition to the risks resulting from changes in climate, weather, and environmental conditions such as changes in seasonal variations, drought, floods, natural hazards, erosion, extreme events and changes in species abundance and composition, and dangerous travel conditions, socio-economic and politically driven challenges include land-use change, lack of power, changing access to food (Ford *et al.*, 2008) no permanent tenure rights (Nebel, 2001), 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). 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). An understanding of the complex interplay between extreme conditions, such as drought, famine and rainfall, and production systems and livelihood strategies is necessary to understand human security (Ifejika Speranza *et al.*, 2008).

Synthesis: Societal and environmental constraints to adaptation may be seen an indicator of decreased human security. Such constraints are identified in some studies (Hovelsrud and Smit, 2010; Pearce *et al.*, 2010).

12.3.1. Indigenous Peoples at Risk

12.3.1.1. State of Knowledge within Human Security Literature

The geographic location and the particular political and economic context will have a bearing on the human security of different indigenous peoples. There are, however, some commonalities that emerge. In many cases indigenous peoples score low on social and economic indicators, and are culturally sensitive to the health of their land and sea (Green *et al.*, 2010). Extreme events emerge as a particular risk for many communities, both indigenous and non-indigenous (Green *et al.*, 2010). Such risks are exacerbated when traditional relocation practices no longer work (Green *et al.*, 2010), or policy creates barriers for adaptation (Wenzel, 2009). Lack of flexibility in where and when to relocate, access to resources, changes in the resource base, encroachment and institutional constraints (Hovelsrud and Smit, 2010), poverty widening disparities and lack of proper entitlements 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). And as for communities in general youth retention, 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).

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 local understandings of risk and local knowledge of hazards and coping strategies (Ellemor, 2005; Finucane, 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 which in the Arctic pose a clear risk that is exacerbated with climate change, indigenous groups have been engaged in direct lobbying and advocacy in an international context (Selin and Selin, 2008). 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.

12.3.1.2. Evidence from the Past

There is a general agreement that indigenous peoples historically have had a high adaptive capacity to highly variable environmental conditions, but less so with respect to socio-economic impacts and globalization. The challenges have more recently been exacerbated by climate change which pose a greater risk than before to such capacity with implications for human security.

12.3.1.3. Evidence about the Future Projections

Future changes will challenge current knowledge systems, adaptive strategies, management practices 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).

12.3.1.4. Synthesis: Cultural Diversity and Climate Change

- Awareness about limitations of current adaptation strategies will increase human security.
- Local perspectives and involvement a key to ensure human security.
- Context dependence a key factor in understanding the linkages between culture and human security.
- The location specific nature of adaptation and local understanding.
- Flexibility a key factor.
- Lack of involvement decreases human security; involvement increases human security.

12.3.2. Threats to Local and Traditional Knowledge and Implications for Human Security

12.3.2.1. State of Knowledge within Human Security Literature

Local and traditional knowledge is often orally transferred, deeply grounded in history and experiential, and therefore highly context dependent. It is also dynamic and changes through interactions and exposures to other forms of knowledge and viewpoints. Incorporation of such knowledge into scientific knowledge will not only "protect" the knowledge and language, but will also increase the indigenous scientific capacity by making their knowledge relevant in another context and thereby increasing the value of both forms of knowledge. 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). This requires openness and acceptance (Tyler *et al.*, 2007). In contrast, some studies discuss how diverse stakeholders and scientists identify competing opportunities and constraints when attempting to reconcile community growth with resilience to natural hazards (Frazier *et al.*, 2010). This raises the question about whose voices are heard and whose knowledge systems carry the most weight in decision-making. Others argue that local knowledge will contribute significantly to national monitoring and assessment initiatives (Kalabokidis *et al.*, 2008; Klintenberg *et al.*, 2007).

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). 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), an important contribution in emergency management (Becker *et al.*, 2008), and important for mitigating natural disasters (Rautela, 2005). Additionally such knowledge has been utilized through history to adapt and mitigate climate change impacts (Nyong *et al.*, 2007), 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 and also integrated into other forms of knowledge (King and Goff, 2010).

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). In some cases, such as 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). The interaction between indigenous knowledge and response and development interventions warrants further discussions (Homann *et al*., 2008). Local and traditional knowledge of the environment is critical for human security at the community level, and for reasserting traditional values (Ford *et al*., 2006). Such knowledge provides insights into what is relevant locally, such as what elements to forecast (extreme events, El Nino, sea ice change, precipitation, temperature, combined climate elements, icing conditions, snow etc), and about the local context and conditions (Hovelsrud and Smit, 2010; Nyong *et al*., 2007; Tyler *et al*., 2007)(Tyler *et al*., 2007). Local knowledge may in this way contribute to scientific knowledge and make it more relevant for stakeholders and users (Oberthür *et al*., 2004; Tyler *et al*., 2007). In many cases scientifically based climate forecast or downscaling results are presented but not necessarily understood well by for example local farmers (Roncoli, 2006). Local perception of what kind of knowledge is trustworthy may question scientific findings (Burns *et al*., 2010; Ingram *et al*., 2002) and how to deal with uncertain climate information (Roncoli *et al*., 2011). There is agreement that forecasts must be relevant and disseminated by a reliable source (Ifejika Speranza *et al*., 2008; Ingram *et al*., 2002). In mountain regions exposed to disasters such as floods (Alcántara-Ayala, 2004), risk is reduced by incorporating local knowledge into policy and decision-making. However, this raises the question of how to best incorporate local/traditional knowledge into the scientific knowledge base; the participatory approach may not be sufficient (Roncoli *et al*., 2011).

Some studies warn that the emphasis on the value of local knowledge may be overrated and suggest that such knowledge may not be sufficient to provide the proper response to a risk or hazard (Nunn, 2000), which may come as a surprise or that there is an element of local ignorance about infrequent events (Kuhlicke, 2010). It may become a risk to the community and individuals if the current local and traditional knowledge is perceived to be less reliable because of changing environmental conditions (Ingram *et al*., 2002). This is by some seen as related to the lack of attention in local communities to global issues, such as environmental change (Ogunseitan, 2003). In other words, local knowledge about local conditions is important as is local understanding about external or global conditions. 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, or when extreme conditions becomes embedded in daily life it may lead to higher vulnerability (e.g. (Burningham *et al*., 2008; West and Hovelsrud, 2010; Zamani *et al*., 2006)).

Erosion and limitations of local and traditional knowledge

Erosion of traditional knowledge occurs through a number of mechanisms (Crona, 2006; Ford *et al*., 2006) including lack of knowledge transfer due to societal factors (Ford *et al*., 2006)Ford et al 2006: 133-134). Changing environmental conditions due to climate change is an additional stress: hunters, may, for example, be forced to switch from one species to another require knowledge about how to track and hunt the new species (i.e. switching from seals to walrus) (Ford *et al*., 2006) (Ford et al 2006: 134). Hunters, for example, may not have this knowledge within their 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). This is also illustrated in the case of coastal communities in India where 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). Assessment of local risks based on experience may underestimate the impact of rare or extreme events (Burningham *et al*., 2008). Erosion of traditional knowledge in the Himalayas occurs through government regulations and environmental protection 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 traditional knowledge (Rautela, 2005). Erosion of local and traditional knowledge increases the vulnerabilities and thereby human security. New conditions require new knowledge, which in turn will increase the flexibility and improve livelihoods (see also (Green *et al*., 2010; Homann *et al*., 2008).

Integration of knowledge systems

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 (e.g. (Anderson *et al.*, 2007; Frazier *et al.*, 2010; Marfai *et al.*, 2008; Vogel *et al.*, 2007). Integration of western and traditional knowledge is highly relevant and useful for enhancing community emergency management (Becker *et al.*, 2008), in disaster risk reduction and management (Mercer *et al.*, 2009), and for combining different knowledge systems with management in the case of fire as a forest management strategy (Bilbao *et al.*, 2010; Kalabokidis *et al.*, 2008). 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 and perceptions (Marin, 2010; Mark *et al.*, 2010), and illustrates the need for incorporating indigenous knowledge and observations into climatology. This supports the notion of creating projections and models that are locally relevant (Hovelsrud and Smit, 2010), and overcoming the barriers to integrating different knowledge systems (see e.g. Kwiatowski, in press).

12.3.2.2. Evidence from the Past

Local and traditional knowledge have been critical for ensuring resilient communities.

12.3.2.3. Evidence about the Future

Future conditions will likely challenge current local and traditional knowledge.

12.3.3. Communities at Risk

12.3.3.1. State of Knowledge within Human Security Literature

Communities, in the context here, are settlements, the populations that live there and the social relations between them. The focus of this section is on the implications of climate change for the collective elements of human security embodied in communities. Actions to cope with impacts and transform communities are constrained by power relations, with much research emphasizing the heterogeneity of people within communities and communities as sites for the negotiation of risk management (Herbert, 2005, Davidson *et al.*, 2003; King, 2008; Nielsen and Reenberg, 2010; Nielsen and Reenberg, 2010). For both local communities and indigenous peoples' the linkages between climate change and human security pertain to livelihoods and cultural activities that are closely connected to natural resource use, access to these resources and resource management and regulations (Hovelsrud and Smit, 2010). Flexibility and livelihood diversification are two key factors when dealing with high variability in a community resource base (de Sherbinin *et al.*, 2008; Desta and Coppock, 2004; Ford *et al.*, 2006).

A community focus, or a bottom-up approach, is necessary to capture the multiple factors creating communities at risk. A macro perspective will not uncover the reasons for why a community does not adapt to hazards or risks (Davidson *et al.*, 2003; Harries and Penning-Rowsell, 2011), while a "genuine community input will result in a robust and comprehensive treatment of risk" (Gero *et al.*, 2011). It is important to not only consider cooperation between the national and the local scale but also between local sectors to reduce vulnerability (Glaas *et al.*, 2010). The interaction among different stakeholders will affect the adaptive capacity, and the lack of tradition and methods for building institutional knowledge will affect communities (Glaas *et al.*, 2010). The participatory approach in vulnerability assessments builds capacity in communities (Fazey *et al.*, 2010; Furgal and Seguin, 2006). Furthermore, the understanding of the social perception of risk, which in an example from Portugal illustrates how it minimizes the risk, is often not integrated into management (Figueiredo *et al.*, 2009). Understanding the local coping strategies that aim at minimizing community risks is also a question of the scale of policy and who the decision makers are (Paul and Routray, 2010a; Paul and Routray, 2010b). Different policy frameworks may create barriers for integrating approaches by community practitioners that may reduce vulnerability (Gero *et al.*, 2011).

Without awareness and dialogue between leadership and community engagement we decrease human security and create communities at risk. Weak institutions may create barriers for action to deal with for example resource use (Burch, 2010) and are an important element of human security. High agreement/highly likely that full participation in risk and vulnerability assessments (e.g. (Ardalan *et al*., 2010) from the community from the outset is most sustainable (Gero *et al*., 2011), which will increase adaptive capacity (Fazey *et al*., 2010). Similarly, the disconnect between science and policy hampers the ways a community can respond to climate change (Tribbia and Moser, 2008).

Changing socio-economic and environmental conditions separate and in combination may create conditions which constrain existing coping community mechanisms (example from Alaska where caribou and reindeer mix in (Rattenbury *et al*., 2009). Other risk factors include the challenge of incorporating climate change in forest management and the difficulty in achieving 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 adaptations to recurring seemingly "normal" events may not be sufficient in more extreme conditions (Paul and Routray, 2010a).

12.3.3.2. Synthesis: The Limits of Community Resilience

Recognizing that systems are complex and that social and natural elements interact is critical for understanding community resilience (Aguilar *et al*., 2009). The components of community resilience include *inter alia* social networks and support, safety nets, informal risk sharing mechanisms, learning, active involvement, collaboration across sectors and societal scales, environment and lifestyle, diverse and innovative economy, different beliefs, and leadership (Buikstra *et al*., 2010; Paul and Routray, 2010b; Pearce *et al*., 2009; Siurua and Swift, 2002). To build resilience entails interaction between individuals, community, infrastructure, the environment and the economy along these dimensions (Buikstra *et al*., 2010). While local level approaches are imperative it is also important to note that the level of community responses is shaped by political and economic globalization. Additionally different drivers of vulnerability at the community level in a fishing village, for example, are closely connected to the resource base of fisheries (Kalikoski *et al*., 2010). There is a strong emphasis on the factors other than climate which adds to vulnerability or reduces resilience (Green *et al*., 2010; Ifejika Speranza *et al*., 2008).Therefore there is a need to consider large and complex interactions beyond community level (Keskitalo, 2009). Institutional change is seen by many studies as being a requirement for ensuring community resilience and reducing vulnerability. Aspects that may weaken the resilience of social-ecological systems may also have a bearing on community resilience. These include breakdown of traditional institutions, rapid technological change and rapid changes in local socioeconomic conditions (Crona, 2006; Seixas and Berkes, 2003).

12.3.4. Adaptation and Managing Risks

12.3.4.1. Adaptation Options for Indigenous Societies and Peoples

Archaeological evidence shows that pre modern cultures had a mixed record in adapting to environmental changes. The Pueblo Indian peoples were able to use a mix of strategies, such as intensification of maize production, multiyear food storage technologies, and local and regional networks of exchange in order to manage drought. However, the responses to intense and prolonged drought were less effective, with famine, social conflicts, and seemingly forced migrations being principal responses (Blinman 2008). Severe drought seems to have been a factor in the collapse of the Akkadian (Mesopotamia), classic Maya (Yucatan Peninsula), and Tiwanaku (Boliva and Peru) civilizations, whereas the Moche civilization in Peru was able to transform and persist in the face of a multi-decade dry period (deMenocal 2001). Nevertheless, as Dugmore and others (2007) show in their study of the decline of the Norse in Greenland, it is difficult to discern the relative influence of climate as compared to co-existing social processes such as changing trade patterns. Thus, like the relationship between climate change and migration (see section 12.4), and conflict (see section 12.5), the archaeological evidence on the relationship between climate and

civilizational collapse suggests that climate can be a factor, but rarely the most important one among other co-existing social changes.

Indigenous people often depend on climate sensitive natural resources to maintain their livelihoods and cultures. Adapting to maintain livelihoods can involve the same strategies of intensification, diversification, or migration, as discussed in Section 12.2.3, and in Chapter 13. However, sustaining material flows in these ways may come at the cost of sustaining important cultural practices and values. In Polynesia, for example, diversifying from producing and consuming talo to potatoes may sustain people's diets and incomes, but it would undermine distinctive aspects of life in these islands because growing, consuming and exchanging talo is a traditional practice that signifies belonging to the land and to society (Barnett 2008). For the St'at'imc people in British Columbia, there may be no effective adaptation to changes in cultural practices that arise from changes in the timing, abundance, and quality of sockeye salmon (Jacob et al. 2010). Some adaptation options may work to sustain people's bodies and incomes, but have such dramatic cultural impacts as to make them ultimately maladaptive. In Funafuti (Tuvalu), for example, some people report that migration to reduce their exposure to sea-level rise would be the worst outcome of climate change because of the effects it would have on their culture and identity (Mortreux and Barnett 2009).

Many communities that have long associations with places have developed knowledge about changes in environmental conditions and ways to manage them that help facilitate adaptation (Crate 2008, Petheram et al., 2010, others). This knowledge can be maintained even though traditional practices may be altered or disrupted by processes of modernization, colonization, dispossession, or forced migration. Nevertheless, the loss of access to places that may be brought about climate change, or by climate change adaptation or mitigation policies, can have significant negative consequences for cultures that rely on the use of sites or symbolic events for ceremonies or traditional practices (Crate 2008, Garrett 2009, Kirsch 2001). The loss of access to places does not imply that those places lose all value to those who are dispossessed, nor that cultures cannot change (Garrett 2009, Kirsch 2001). There is some consensus, though, that cultures removed from their important material elements are diminished, and more endangered, and that this is not something that can be 'adapted' to in the sense that there can be no effective substitutions of or compensation for lost sites of significance (Adger et al. 2011, Garrett 2009, Kirsch 2001).

12.3.4.2. Local and Traditional Knowledge as a Means to Enhance Human Security and Well-Being

Some cultures are more able to adapt to change than others, and those – such as many Indigenous cultures – that regard society and nature as being mutually obligated may be more predisposed to accepting and responding to changes in environmental conditions than those that are based on a more exploitative or adversarial relationship to nature (Heyd 2007). Thus, how material elements of the environment are interpreted and given meaning influences the ways in which adaptation transpires (Kuruppu 2009).

The usefulness of local knowledge and practices for adapting to climate change depends on the rate and magnitude of change in environments caused by changes in climate. The changes that may be anticipated in the future may have no historical precedent, and so may surpass the ability of traditional knowledge and practices to adapt to them. In the Marshall Islands, for example, local people actively manage many of the local resources that are likely to be impacts by climate change, including the coastal zone, key food crops, and freshwater resources, and they share harvests of these such that their distribution is relatively equitable (Bridges and McClatchey 2009). Yet, faced with significant sea-level rise, ocean acidification, and changing rainfall patterns, this knowledge may be inadequate for responding effectively in the future (Barnett and Adger 2003).

The distinction between knowledge about climate change that is traditional and local, and that which is received from outsiders, is not easy to make, yet it seems clear that much of what local people know about climate change is influenced by the media, awareness raining programs, film and literature (Bravo 2009, Rudiak-Gould 2011). Some of the most immediate impacts of climate change came from the way the idea of climate change is received and internalized, for example people in both Kiribati and the Marshall Islands merge scientific information about climate change with pre-existing Christian narratives about cultural decline in ways that discourage meaningful engagement with adaptation (Kuruppu and Liverman 2011, Rudiak-Gould 2011).

12.3.4.3. Community Resilience, Adaptation, and Human Security

Resilience is not necessarily a function of income. In some cases, lower caste groups, who traditionally have lower incomes, have been shown to be more able to adapt to changing environmental conditions than those with greater wealth and social status. Thus, lower caste *Dalit* fishers in the Pulicat lagoon in India, who are not traditional fishers, and who have been allocated less productive fishing grounds than nearby *Pattinaver* fishers, are able to sustain incomes during lean fishing periods through 'poor man's' fishing practices that involve using diverse techniques, and through working in other sectors, whereas *Pattinaver* fishers have been unable to adjust, and consequently experience falling incomes (Couthard 2008). A similar situation exists among pastoralists in Burkina Faso, where the *Rimaiibe* people, who were formerly slaves of the *Fulbe*, have effectively diversified their livelihoods in response to drought through more extensive use of labor migration, whereas the *Fulbe* have been less willing to seek such alternative income streams due to cultural barriers (Nielsen and Reenberg 2010).

Resilience is a function of many factors, such as how societies are governed, organizational cultures, leadership, and decision-making procedures (Burch 2010). Static hierarchical structures, such as those that occur within some churches in Kiribati, are not amenable to change (Kuruppu 2009). Trust in government is important, and where there is a history of miscommunication and mistrust between local people and governments the effectiveness of government-lead adaptation initiatives is curtailed, such as is the case between Indigenous people in Arnhem Land and the Australian and Northern Territory governments (Petheram et al., 2010). In this case, Yolngu people regard a greater degree of local autonomy and empowerment as being key to climate change adaptation. Poorly considered if well-meaning attempts from outsiders to help Indigenous people may only further undermine their ability to adapt to climate change (Bravo 2009, Petheram et al, 2010).

12.4. Migration and Mobility Dimensions of Human Security

12.4.1. Internal Migration

12.4.1.1. State of Knowledge within Human Security Literature

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

Migration occurs for many reasons, but the primary explanation for migration from demographic theory is that it reflects differences in expected economic opportunities, with populations moving to places to take advantage of these differences. Migration is therefore seen in economic development literature as one of the prime sources of economic growth, with migrants forming the basis of growth in industrialised sectors and one of the main drivers of urbanisation globally. Economic differences between source and destination locations and social factors are the primary drivers of observed migration with climate and environmental factors playing a role in particular types of migration from specific regions (Suhrke, 1994; Piguet et al. 2011; Chopra and Gulati, 2001).

The human security dimensions of migration focus on whether environmental, political or other forms of insecurity cause involuntary migration; the conditions of migrants in destination regions and cities; the demographic impact of migration on households by age and gender; and the impact of short-term hazards on migration and displacement. International migration also involves legal and institutional dimensions and specific issues of security and social cohesion.

The single largest trend in migration over the past century has been rural to urban migration, with migration representing the majority of urban population growth in some regions. The proportion of urban population globally has risen from 10 percent in 1900 to over 50 percent presently. The UN projections of urban growth (UN Habitat 2011) suggest that by 2030, 59 percent of global population will live in urban centres, with over 90 percent of the

increase by 2030 being located in cities in the developing world, with a significant proportion caused by migration. The growth of cities poses many challenges for sustainability at local scales (Grimm et al., 2008). A smaller proportion of migrants move from one country to another, though the proportion of international migration is fairly static.

Climate change impacts are likely to affect all issues of human security of migration and mobility. In addition, climate change may have specific implications for pastoralist and other economies where mobility is one of the prime strategies for dealing with climate variability on a seasonal or inter-annual basis. 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). The few predictive studies model impacts of climate change on the viability of continued habitation and assume displacement as a result of a threshold of land inundation or resource productivity. These studies have, for risks such as sea level rise, quantified potential displacement (Nicholls et al., 2011). But displacement is only one element of migration and does not suggest timing, destination, or human security elements. There is mixed evidence on whether any major observed human migration flow has been caused by the impacts of climate change. The differences in emphasis are partly explained by methodological differences. 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.

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. Some of these methods also support predictive modelling or scenarios of future migration trends or destination areas; or derive inference about the future from historical analogues (McLeman and Hunter, 2010). A small number of scenario studies seek to define 'hotspots' where large-scale migration may involve conflict and breakdown of social cohesion (WBGU, 2008).

12.4.1.2. Observational Evidence on Mobility and Displacement

Drought or changes in resource scarcity

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 of these mechanisms.

The majority of the scientific literature on climate and migration, drawing on a range of methods and scales, focuses on explaining whether climate impacts have affected dimensions of migration: displacement, existing seasonal mobility, and urbanization trends. All of this research suggests that virtually all migration decisions involve multiple factors with economic opportunity being a primary driver. Hence population displacements 'are always a result of a multicausal relationship between environmental, political, economic, social and cultural dimensions' (Piguet, 2010, p517). The search for evidence on migration outcomes has focused both on circumstances where there has been significant climate-related impacts (such as drought, floods and landslides), or at significant movement of people to disentangle the climate signal in that movement.

One consistent theme from the literature on climate and migration is that while mobility and migration responses to climate-related hazards are common, movement is costly and disruptive and hence may only be used as a 'adaptation of last resort' (McLeman, 2009). Hurlimann and Dolnicar (2011) surveyed residents in eight Australian settlements and showed that relocation and migration was perceived to be the least desirable adaptation and would be resisted by present populations. Haug (2002) showed that pastoralists displaced as a result of drought in Sudan in the 1990s similarly attempted to return to their previous settlements as soon as possible after the drought, notwithstanding conflict and other factors.

In addition, 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) review historical cases of displacement migration and conclude 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, often, but the evidence is mixed on whether they amplify existing migration trends. Barrios et al. (2006) used statistical modeling of changes in rainfall to explain migration rates to African cities. They found that the observed rainfall decreases in decades during the past fifty years explained some of the differences in urbanization rates in Africa, with shortages in rainfall increasing rates of urbanization in sub-Saharan Africa, often propelled by simultaneous liberalization of movement in post-independent countries in the region. Their results are not replicated in other parts of the developing world. Findley (1994) examined migration responses to drought among pastoralists in Mali in the 1980s showing an increase in temporary and short term migration, but a decrease in long distance, permanent or international migration as a result of drought. These results are confirmed in a multi-year study of Mali in the 1990s (Henry et al., 2004) that showed the movement to other rural areas increased in dry years, but long distance or international migration was limited to years of high agricultural productivity.

Jonsson (2010) reviewed these among 13 studies of migration and drought in West Africa and confirms the conclusion that long distance migration is reduced by drought in pastoral systems. These insights are based on well established findings of migration trends, that all pioneer migration to urban centres requires significant human and financial capital and hence is restricted in the first instance to wealthier populations. When drought in an agricultural based economy reduces real incomes, the resources required for long-distance migration are reduced. In dryland regions, pastoralists have long established strategies and mechanisms for dealing with uncertainty. For arable agricultural systems, Gray (2011) shows a similar result – that reductions in soil quality (for example through increased erosion) increases temporary labour migration in Kenya, but that in Uganda it takes greater agricultural income to provide the income and resources to enable migration.

Extreme events

Increased exposure to flooding and extreme weather is associated with significant displacement of populations as settlements and homes are directly affected. There is a very well-established literature on the processes of migration, displacement and return migration as a result of disasters, ranging from hurricanes to coastal flooding, river flooding, tornadoes and other events. Much evidence shows a distinct temporal dimension to displacement ranging from localised and short-term movement of people, through intra-regional migration, through to international displacement as a result of large scale events. There is little evidence that the scale of impact determinants the distance or permanence of migration. The Pakistan floods of 2010 caused primarily localised displacement for large numbers of people across a wide area. Rather the distance and permanence of migration is best explained by established migration links and past experience (McLeman and Hunter, 2010).

The evidence on displacement as a result of climate-related extremes suggests that most people displaced attempt to return to their original place of residence and rebuild as soon as practical. There is some conflicting evidence on whether migration is the dominant response to such events. In a study in Bangladesh, Paul (2004) found that there was little displacement as a result of flooding in storm affected villages and that resident perceived that there had been an influx of migrants as a result of the reconstruction efforts. But the structural vulnerabilities also affect the ability to cope without migrating. McLeman and Hunter (2010) and Glantz and Jamieson (2000) assess the evidence of the impact on Hurricane Mitch in 1998 across different central American countries. Across the affected region, the storm displaced up to two million people either temporarily or permanently. But 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 in the years after Hurricane Mitch. But the impacts of such events are highly uneven. McSweeney and Coomes (2011) studied rural settlements in Honduras before and after Hurricane Mitch using longitudinal surveys, and found that

while the poorest households were hardest hit by the hurricane, changes in land tenure and support meant that this part of the population were less vulnerable to subsequent storms in the late 2000s and less likely to be displaced.

In general, the structural causes of vulnerability, such as income inequality, race and class, are found to have a profound effect on the likelihood of displacement and the consequences for return. The migration and displacement associated with the impact of Hurricane Katrina in New Orleans and Louisiana has been studied extensively since 2005 and provides evidence on the impacts of large scale climate-related hazards that are common to many situations. In New Orleans economically disadvantaged populations were displaced in the immediate aftermath of the storm and it is the disadvantaged populations that have been found not to have returned for longer periods (Myers et al., 2008). Fussell et al. (2010) studied return migrants 14 months after the event and found that black residents returned to the city at a much slower rate, even allowing for differences in income, mainly because they suffered greater housing damage in the original storm. Adams et al. (2009) examined the permanent displacement of New Orleans residents and identified factors that have led to 'chronic disaster syndrome' that has meant that some populations are unlikely to return. Hori and Shaefer (2010) suggest that displacement affected the human security through housing, economic and health outcomes with those displaced, especially for those displaced over greater distances or permanently, being particularly affected in a negative manner.

There is some evidence that migrants are more at risk from the impacts of weather-related hazards than other social groups. First, new migrant groups in cities cluster in high-density areas with exposure to hazards such as flooding and landslides. Evidence from Buenos Aires, Lagos and Dakar (Mehrotra et al., 2011; World Bank, 2010) shows that migrants are more likely to be exposed to weather-related hazards than longer term residents. For Dakar, 40 percent of new migrants over 1998-2008 reside in areas designated as high flood risk. In Shanghai, Wang et al. (2011) found that migrants had less knowledge about typhoon risks and in the Cayman islands, Tompkins et al. (2009) show that new migrants are the most vulnerable to tropical cyclones as they tend to fall into the demographic groups least likely to prepare for cyclones, live in locations with high levels of exposure to cyclone impacts, and interact mostly with other expatriates with no previous experience of cyclone impacts.

12.4.1.3. Evidence from Projections

The scientific literature on migration is therefore beginning to show a detailed account of how climate change interacts with migration trends and drivers, and the policy implications of those. Virtually all the scientific literature is dismissive of early attempts to define and quantify displacement as the prime migration issue. The estimates of 'environmental refugees' proposed by Myers (2002) and others and repeated in policy documents and, for example, in Stern (2007), have largely been dismissed (Black et al., 2011; Taccoli, 2009; Piguet, 2010) as not being consistent with knowledge of multi-causal migration processes and observed evidence of responses to hazards or longer term climatic changes, nor factored in other adaptation strategies (Gemenne, 2011).

The most important contribution of future projections is on where land will likely be uninhabitable and hence where displacement will inevitably occur. Such displacement is likely from sea level rise, erosion of coasts and from extreme drying and hence loss of productivity in marginal agricultural lands. For dryland Brazil, Barbieri et al. (2010) estimate emigration rates from the rural economy to other parts of Brazil to 2050 based on climate change impacts on the agricultural sector (using IPCC A2 and B2 scenarios). They find that migration is sensitive to such changes in agricultural incomes, and that de-population occurs in the long run even with relatively modest rates of warming. The greatest absolute impact on migration rates in their scenarios comes from relatively productive agricultural areas which support the greatest agricultural labour force. Medelsohn et al. (2007) similarly conclude that emigration to cities is a highly likely consequence of agricultural income loss in dryland Brazil.

Nicholls et al. (2011) estimate global and regional populations displaced based on a range of potential sea level changes till 2100. They find large variation in projected numbers displaced depending on whether countries invest heavily in coastal protection. A 0.5m sea level change amounts to a total likely land loss of 0.877 million km^2 by 2100, displacing a population of 72 million people, assuming no adaptation investment. If sea level rises by 2.0 metres, then 1.789 million km^2 would be lost, displacing 187 million people, or around 2.4 percent of global population. These estimates fall substantially to 0.041-0.305 million people displaced by 0.5-2.0 m of sea level rise

if all coasts were protected with dikes and beach nourishment. Hallegatte et al. (2011) suggest that such protection measures are very likely as the cost to economies of not investing in protecting urban land and infrastructure is so great. This would suggest that some adaptation will occur, though Nicholls et al. (2011) and Repetto (2011) also consider that such adaptations may not always be effective or well implemented. For all cases reported by Nicholls et al. (2011), the majority of displacement would occur in Asian coastal regions. Existing migration trends are also likely to exacerbate impacts of climate change and vulnerability themselves. In coastal regions in particular, 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 but that migration raises this estimate to 35 percent.

12.4.2. International Migration

12.4.2.1. State of Knowledge within Human Security Literature

Given that past migration trends are an important predictor of future migration trends, much work on international migration affected by climate change examines existing important flows of migrants. Present important migration routes include to the US from neighbouring countries; to Gulf countries from Asian countries; within the developed countries of Europe; and trends towards depopulation of isolated islands. Much international displacement migration is associated with conflict in source regions. Projections of growing international migrants (2010-2050) indicate that the USA is the major net receiver, followed by Canada, the UK, Spain, Italy, Germany, Australia and France, while Mexico has the highest number of emigrants followed by China, India, Philippines, Pakistan, Indonesia and Bangladesh (United Nations, 2010). There are no reliable global statistics exist on environmentally triggered or climate-induced migration, and even less on people who opt or are forced to leave their livelihood due to climate change effects, with no major UN agency including 'environmentally-induced migration' in their data.

12.4.2.2. Observational Evidence

There is divergence between evidence based on observational evidence of migration patterns and those based on projections. This can be explained by the range of different methods used. Projection studies rely either on quantitative methods where difficulties arise in whether relationships hold to the future; or on scenarios, where again assumptions of past migration flows may not be reliable. Much observational evidence on migration is able, through qualitative analysis, to encompass a broader range of the social and cultural dimensions of migration, such as the role of networks and migration identities in decisions of whether to move and where to move to (see Piguet, 2010; Black et al., 2011). Hence observational evidence on migration tends to suggest that migration rates are a routine social and economic practice of which environmental change are, apart from in exceptional circumstances of displacement, a small component within migrations decisions. Projections tend to suggest a greater sensitivity to climate change impacts.

Mortreux and Barnett (2009) interviewed households in Tuvalu where virtually every family have some members who have migrated internationally. They 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 chosen to remain for reasons of culture and identity. Shen and Gemenne (2011) interviewed both Tuvalu residents and migrants from Tuvalu in New Zealand and concur that migrants 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 international migration in the future. Along with many other studies, 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.

12.4.2.3. Evidence from Projections

There is a thin evidence base of studies on future projected international migration associated with climate change impacts. This paucity of evidence may be explained by both the lack of good data on international migration sources and destinations in the present, and by the complexity of causation in defining migration motivations and decision-making. Most studies that have made projections of international migration, find sensitivity of migration rates to climate. Marchiori and Schumacher (2011) develop a stylized economic model of migration between two countries and examine how migration policies, climate change impacts, and investment in green technology interact. They find that climate change impacts tend to increase international migration rates and that investment in green technology bringing convergence in real wages, reduces international migration. These results have not been tested with international migration and economic data.

Feng et al. (2010) use state level data on migration in Mexico to investigate 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 and use the coefficients to project emigration rates under scenarios of climate to 2080, making various assumptions about adaptation options within agriculture. Their projections show between 2 and 10 percent of the working age population of Mexico could potentially migrate to the US due to declines in agricultural productivity. Such projections depend on many other factors remaining constant, such as relative real wages in US and Mexico not contracting. Such projections also fail to account for the social and demographic elements of where migrants choose as destinations, nor the role of circular transnational migration. The implications of rural depopulation could be profound, with Radel et al. (2010), for example, showing how farming households in Mexico adapt labour practices giving women greater autonomy affecting food security and sustainability.

The greatest focus of research on future projections where international migration is prevalent is on the impacts of climate change on small economies and countries where virtually all migration is international and where displacement is the assumed major impact.

12.4.3. Adaptation and Managing Risk

12.4.3.1. Evidence on Migration as an Adaptation Strategy

From a human security perspective migration and mobility are adaptation strategies that manage risksin highly vulnerable places. Migration has, in addition, multiple eco-systemic, communal, socioeconomic, environmental and cultural challenges for water, food, health and livelihood security.

Due to the lack of agreed key concepts and global statistics on climate-induced migration, the question if migration has been or may be an adaptation strategy cannot be answered globally. However, on a country scale empirical evidence indicates links between socio-economic and environmental reasons for migration that have forced people to move temporarily after a disaster, and internally to towns or internationally due to long droughts and loss of harvests that often create new pressures on fragile ecosystems elsewhere. The section above has suggested two offsetting trends:

- As climate changes become more severe, there will be greater disruption to traditional patterns of mobility among highly mobile populations (such as nomadic economies and fisheries), limiting adaptation options;
- At the same time migration induced by inundation or decline in resource productivity in rural areas is more likely to be permanent (Warner, 2010; Gemenne, 2011).

These observations raise important issues of how migration is being used and potentially could be enhanced as an adaptation to climate change impacts. Most of the policy options relate to internal movement of people within countries. Much literature has argued for greater emphasis on mobility within adaptation policies (Barnett and Webber, 2010' Bardsley and Hugo, 2010; Warner, 2010; Gemenne 2011). Much of the evidence in these analyses is based on careful social science 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 main areas of

government intervention: using social protection mechanisms such as cash transfers to reduce the likelihood of temporary displacement from weather-related extremes (Johnson and Krishnamurthy, 2010); adaptation in destination regions, such as reducing the vulnerability of migrants in growing urban areas; protection and assistance of migrants as they move, particularly international migrants, in terms of rights to citizenship and ability to make economic linkages to source regions and countries; and 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)). 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.

12.4.3.2. Evidence on Policy Issues and Governance of Migration

Every country has policies governing and facilitating the movement of people within their borders and internationally. No country to date has policies in place to deal with migrants who are displaced internationally as a result of environmental change (Martin, 2009). For internal migration, government policies are also embedded in global governance, such as the principles within the Universal Declaration of Human Rights (1948) that notes that people 'have the right to freedom of movement and residence within the borders of each state'. Policy responses to migration as an adaptation strategy within countries are discussed above.

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. This literature focuses on strategies for adaptation, mitigation and resilience building are needed to *protect* and to *empower* both internal and international migrants triggered by climate change. On the global level, no international migration regime exists. No international legal regime entitles climate-induced migrants to stay temporarily or permanently in another country. Several legal proposals have been made suggesting new multilateral conventions, or compensation mechanisms to countries where the population is forced to migrate (e.g. Biermann and Boas 2009, Williams, 2008; Bryavan and Rajan, 2006; Docherty and Giannini, 2009; McAdam, 2011). 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).

The arguments against a new international governance mechanism to deal with international displacement focus on the practical as well as conceptual difficulties of developing such an instrument in international law. All migration and climate studies point to the amplifying rather than primary role of climate and environment in triggering migration decisions. Hence, in practice many legal scholars foresee difficulties in assigning causation to one trigger of migration compared to conflict or poverty. A second strand of literature focuses on the geo-political implications of changing the Geneva Convention on refugees to include environmental migrants as well as the present lack of global instruments to handle internal displaced peoples as well as international migrants (Martion, 2009; Cournil, 2011). A third strand of literature focuses on the implications of climate migrant status on the practice of international migration, where the rights of migrants to full citizenship and economic status in destination countries are often not realised (McAdam, 2011; Hartmann, 2010). In addition, many small island countries are reluctant themselves to have their regular international migration designated as being victims of climate change (MacNamara and Gibson, 2009; Farbotko, 2010)

12.5. Social Cohesion, Conflict, and Scales of Insecurity

12.5.1. Local Social Cohesion and Conflict

12.5.1.1. State of Knowledge within Human Security Literature

The term social cohesion concerns patterns of interactions among groups and individuals within a society which contribute to stability and well-being. The concept is multidimensional and not easily susceptible to crisp definitions. Nonetheless there is broad agreement in the literature and among policy makers that social cohesion encompasses an interlinked set of phenomena including the following (Chan et al. 2006, Duhaime et al. 2004):

- Social capital, trust in institutions, and participation in local organizations;
- Social inclusion and networks of support;
- Economic inclusion and opportunities for gainful employment and livelihoods
- Secure sense of place and mobility and freedom from fear of losing access to one's geographic community
- Quality of community life and feeling of safety and satisfaction

Social cohesion can therefore be seen as constituent of human security. In addition, these elements of social cohesion can also be seen as risk factors that shape patterns of violence within a society.

12.5.1.2. Observational Evidence

There is little evidence that different climatic regimes are associated with different levels of social cohesion. Even highly marginal climates are capable of supporting high levels of social cohesion. For example, some nomadic pastoralist communities in semi-arid regions are able to sustain highly resilient and cohesive communities (Galvin, 2009). Empirical evidence that climate change might contribute to deteriorations in social cohesion stems from statistical relationships between climatic variability and elements of social cohesion. The general pattern that emerges across these relationships is that interannual variability in climatic outcomes does not exert a consistent effect across all societies. However, the data available to carry out robust research is very limited and therefore all generalizations should be considered to have high uncertainty.

Regarding the specific case of low-level organized violence, in northern Kenya a study found that that periods of abundant rainfall are associated with greater frequency of such violence (Meier et al., 2007), but this relationship has not been found in other regions.

There is a small set of findings that as temperatures rise people become more aggressive, holding other factors constant (Kenrick and Macfarlane 1986, Larick et al 2011). However these findings have not been connected to broader patterns of social cohesion.

12.5.1.3. Evidence from Projections

The possibility that social cohesion may be threatened by climate change stems not from explicit modeling that includes direct parameters of social cohesion, for which the required data and methods are not available. Rather, it stems from qualitative analysis linking what is known about likely climate impacts on rainfall, food security, coastal erosion and related stresses to social responses. The claim is made that if climate change is likely to generate a range of impacts which are known to put stress on social cohesion, then it is likely that climate change will erode social cohesion in some places.

12.5.2. Human Security in Conflict and Post-Conflict Regions

Countries that are in conflict or recently emerging from violent conflict have distinct risks. Political institutions are often weak, making it difficult to provide the kind of services that would help societies cope with climate impacts.

The social disruption that often accompanies warfare, such as population movement, livelihood loss, and infrastructure damage, also combine to accentual potential climate impacts. The presence of one form of conflict is typically a very high risk for the emergence of another form of conflict; for example civil war is a risk factor for genocide (Harff 2003). About half of all conflicts occur in countries that have had conflict in the recent past and have relapsed into further conflict (Collier et al 2008).

There is widespread concern that climate and related risks have not received adequate attention for conflict and post-conflict regions, and this concern has been reflected in the emergence of a number of national and international programs aimed to improve the management of climate risks in such areas (UNEP 2009).

To better understand how climate impacts will be affected by patterns of conflict, we would need information on two questions. First, to what degree, and in what way, does the presence of ongoing or recently ended political conflict magnify impacts from climate stress? Scientific research about the precise manner in which climate change is likely to affect conflict and post-conflict regions is limited, in part because of the unfortunate fact that data on human impacts from climate-related stress are especially sparse precisely in these areas. Second, what are some plausible trajectories of future conflict trends, against which to juxtapose estimates of climate impacts? Trajectories of future conflict trends are not well established in the literature, making it impossible to create robust estimates of net risks that take into the interactions of conflict and climate risks.

We can say some things with a degree of confidence. In regions where conflict risks are currently high and not expected to fall quickly (as in very poor regions with weak political institutions and histories of recent conflict), the possibility that there will be significant levels of political conflict in the coming decades is high. The background rate of major political crisis is about two per year (Goldstone et al 2010)**. With very high confidence we can therefore conclude that there will be a significant number of new major political conflicts in the next few decades**. Based on qualitative information about the impact of political conflict on social services, population movement and economic development, **we can also say with high confidence that where conflict emerges climate stress is more likely to diminish human security than elsewhere.**

12.5.3. Internal War and International War

12.5.3.1. State of Knowledge within Human Security Literature

Internal war, defined as major organized armed conflict aimed at achieving a political objective such as seizing control of a government, has been studied extensively using quantitative and qualitative techniques (Blattman and Miguel 2010). The existence of comprehensive data on internal war and advances in theory and modeling techniques permits systematic testing of competing risk factors as well as providing a rudimentary predictive capability. Some risk factors are acknowledged as clearly significant by almost all social scientists studying internal war. These include level of economic development, type of political regime, and existence of conflict in neighboring regions. Figure 12-1 shows robust negative correlation between the incidence of civil war (proportion of all countries engaged in low level violence) and average income within the countries, demonstrating that civil war and conflict is concentrated in poorer countries. Of these risk factors, level of economic development is the most universally acknowledged – poor countries are much more likely to experience internal war than others. Other risk factors remain contested in the literature, including the presence of a youth bulge, the presence of economically valuable raw materials, and ethnic divisions.

[INSERT FIGURE 12-1 HERE
Figure 12-1: Incidence of civil war 1960-2005 related to income per capita (Blattman and Miguel, 2010).]

International war, major armed conflict between countries, is less well understood. Efforts to blend quantitative and qualitative methods have not produced the same level of consensus on the causes of international war, as compared to internal war (Levy and Thomson 2010). Most scholars agree that characteristics of the international political system as a whole exerts a great influence on international war propensity, and the fact that the Cold War ended very

recently and instances of international war remain rare make it almost impossible to test competing risk factors that are relevant for the current environment, much less provide a predictive capacity.

12.5.3.2. Evidence from the Past

The questions that we would like to be able to answer include the following:

- Will increases in average temperature affect the likelihood of war?
- Will changing patterns in interannual variability affect the likelihood of war?
- Will sea-level rise affect the likelihood of war?
- Will major, lasting patterns in weather regimes affect the likelihood of war?

The social science research on these questions are dominated by two types, those that explore the relationship between variability in rainfall and war and those that explore the relationship between large-scale disruptions in weather regimes and civilization collapse.

Several studies have found a statistical relationship between interannual climate variability and the likelihood of internal war emergence. 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. Hsiang et al. (2011) find that in countries that are teleconnected to physical ENSO effects the risk of internal war rises significantly during an ENSO period. 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. For countries that are otherwise already at risk of internal war, rainfall stress significantly raises that risk.

The correlations in time and space between rain shortages and internal war outbreak are established with high confidence. In the past 30 years when rainfall has dropped significantly below average the risk of internal war has risen significantly. Whether this correlation reflects a strong underlying causal mechanism remains the subject of scholarly debate. Some scholars have argued that the relationship is heavily dependent on model specification and should not be considered causally robust (Buhaug 2010). Whether or not changes in rainfall patterns will generate a corresponding change in internal war patterns, therefore, is not a question that is known with the same degree of confidence. Poorly specified causal mechanisms and inadequate methods for constructing socioeconomic scenarios on phenomena as complex as war combine to make this a question on which there is low agreement and limited evidence.

The evidence that climate-related natural disasters in general contribute to conflict risk is not well established. Some studies have found a link, but others have not.

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 proposition that major changes in weather patterns coincided with the collapse of several previously powerful civilizations is known with very high confidence**. It is supported by both a range of physical climate data and documentary evidence. 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 is one in which there is low agreement and limited evidence.

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), but this finding is not well established.

The research on water scarcity and international war shows that historically disputes over shared water resources have not contributed to warfare and possibly may heighten possibilities for peaceful interaction (Wolf 2007). **The lack of a historical correlation shared water resources and international war is known with very high confidence**. The implications of this finding for the future are not as well understood, owing to problems of methodologies for exploring with confidence complex responses to novel conditions.

12.5.3.3. Evidence about the Future

Only one published study has sought to project incidence of internal war in the future using projected climate change as a driver (Burke et al. 2009). It found 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. This finding is not considered robust owing to methodological limitations linking observed past correlations with future events (Buahaug 2010).

Efforts to project the likely impact of climate change on war incidence are limited by the lack of established methods for projecting future conditions which are known to mediate between climate shocks and secondary effects, whether livelihoods or war outbreak. In particular, projects of these types of climate impacts lack a method for varying characteristics of political regimes and of social inequality, both of which are known to affect the impact of climate shocks.

A handful of scenario exercises have been done seeking to understand how climate change might affect the risk of war. Many of these have been done by military intelligence agencies and remain classified. In general they support the conclusion that climate change may have the possibility to tip the balance toward internal war where conditions are already ripe for such an event.

12.5.3.4. Synthesis: Climate Change and War

There are no theoretical reasons to think that climate change by itself could trigger war, but there are very strong reasons to think it might elevate the risk of war probabilistically. The research to date has only partially illuminated the degree to which we can expect it to do so.

The most robust scientific findings linking climatic factors to warfare have to do with interannual variation in rainfall. For countries already at risk of war emergence, experiencing lower than average rainfall can significantly elevate the likelihood that war will break out. As long as there are countries at risk of experiencing civil war, rainfall shortages will probably constitute a source of elevated risk absent countervailing adaptive measures. Where climate change is expected to increase the severity and frequency of rainfall shortages, there is a reasonable basis for thinking that warfare risk, relative to what it would have been absent climate change, will be elevated in the absence of countervailing adaptive measures. **This relationship can be measured statistically using historic data, is compatible with dominant social science theories of war outbreak, and is known with high confidence.**

Other impacts of climate change, considered as direct stresses on the war-proneness of societies, are less well understood. Increase in average temperature, long-term shifts in rainfall regimes, changes in coastal storm patterns, and sea-level rise are all projected climate change impacts for which we lack an empirical basis for projecting direct impacts on war likelihood.

For indirect impacts on war likelihood, however, the possibility that climate change may elevate war likelihood is high. The most well-established risk factor for internal war has to do with the level of human well-being. Deprived populations are more war-prone. **With medium confidence we can say that climate change, because it 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, will elevate the risk of internal war through the negative impact on well-being.

In the past dominant patterns of warfare changed dramatically in response to underlying transformations in technology, ideology, demography and social structures. There is no universal constant when it comes to war. To anticipate the impacts of climate change on war risk in the medium to long term requires anticipating the other factors that will combine to shape war risk.

12.5.4. The Upscaling of Human Insecurity

12.5.4.1. State of Knowledge within Human Security Literature

Climate change-related threats to human security can aggregate or occur on a scale that poses challenges for states and groups of states (WBGU 2008). These state, regional, or international scales, present challenges to established political, economic, and social concerns of the state. Gilman et al. (2011) group the types of challenges presented by the upscaling of human security into three groups utilizing categories from Collier and Lakoff (2008). First, sovereign state security focuses on protecting the territorial integrity and continuity of the state. The ability of climate change impacts to change the position of land-based or maritime borders or to result in the loss of territory through sea level rise present existing concerns in this category (Busby, 2008). Gilman et al. (2010) also cite internal or external threats from 'militarized resource competition'. Second, population security focuses on protecting the well-being of the population on aggregated levels. Climate-related threats to health, food systems, water, or the economy constitute the second category. These threats pose direct threats to the population given the connection to human security, but the impacts at higher scales also undercut the state's ability to protect its most basic state sovereignty security. This category also includes threats from second order impacts of climate change such as movement of people within and across borders. Third, vital systems security emphasizes threats to critical infrastructure of the state. This third category encompasses hazards and extreme events that can compromise transportation, energy, water, or agricultural infrastructure.

12.5.4.2. Observational Evidence

The loss of Arctic ice is prospectively opening access to valuable natural resources that were formally inaccessible and creating new transportation routes that would significantly change patterns of shipping. The changes are also creating or reviving terrestrial and primarily maritime boundary disputes among Arctic countries (Lusthaus 2010). Symbolic assertions of sovereignty have generated heated political rhetoric but little evidence of conflict. The continued extreme conditions, despite large changes in sea ice for example, make operating in the region very difficult and expensive. Political institutions such as the Arctic Council are also providing a newly prioritized forum for resolving resource sharing and boundary disputes. The political and economic importance of the Arctic basin is expected to rise in future decades but there is little evidence that it will become the locale for violent conflict or a new Cold War (Young 2011).

The impacts of climate-induced water variability on transboundary water basins constitute a second cluster of upscaling human security concerns. The high levels of dependence on transboundary rivers such as the Nile, Mekong, and Indus connect the conditions of the rivers with national level development trajectories. Transboundary basin institutions and international legal mechanisms have developed but remain relatively weak tools for collaboratively managing this resource. Climate change promises to affect the timing and rate of flow of these rivers, contributing to concern over negative development and political outcomes from additional stresses (Conca et al, 2002; Wolf et al. 2011).

Climate change impacts on food production and water availability constitute a third example of upscaling human security concerns (Brown and Funk 2008). One of the upscaled manifestations of food and human insecurity is presented by a response to the 2008 food price spikes. Wealthy water scarce and food importing countries have

reacted to the 2008 food price spikes with an adaptation strategy that goes beyond relying on international food trade. High prices and the imposition of national food export restrictions by food producing countries shook importers confidence in trade. The subsequent 2010 Russian wheat export restrictions in reaction to Russia's severe drought and fires reinforced doubts about a purely market approach to import food. Countries such as China, South Korea, Saudi Arabia, and other Middle Eastern states have bought or leased land in poor countries to bolster their food security. The extent of nation-state long-term land deals for agriculture is poorly understood as the terms of many agreements are not typically made public. Subsequent assessments starting in 2009 covering 2000-2010 have revised the figures to the current best estimate of at least 80 million hectares with 50 percent in Africa. Early analysis of the economic impact for host governments suggest they are limited in terms of jobs creation and wider development benefits. Domestic political reactions to finalized or proposed land deals have directly affected state capacity and legitimacy in selling countries such as the proposed South Korea deal to lease half of Madagascar's arable land for 99 years contributing to the grievances stated by the parties that overthrew the then government.

New research modeling virtual water trade (in the form of food) from water-rich to water-poor countries suggests that this land deal approach is a rational one for wealthy water poor countries concerned with food security (Suweis et al. 2011). Most food importing countries are reliant of just a few food exporters, making them vulnerable to food export restrictions and higher prices that have been associated with extreme weather events (fires and floods) and price spikes. In an arena with just emerging informal norms, these overseas land deals carry significant risk for contributing to perceived regime illegitimacy and protests from disadvantaged constituencies.

12.5.4.3. Evidence from Projections

Projections for state sovereignty suggest tie directly to the summary of evidence in section 12.5.3. Given continued population growth in many regions, the relatively higher levels of rate of change in consumption levels of natural resources, and anticipated climate impacts, some projections suggest the future will not look like the past with the more modest evidence base for organized violence among and between states. These projections emphasize rate of change rather than absolute or relative scarcities per se in undercutting institutional ability to channel conflict into peaceful or cooperative outcomes.

Other projections suggest a focus on formal conflict is insufficient for state sovereignty despite the state's traditional focus on this type of threat. The aggregation of anticipated impacts on infrastructure, agriculture, health, and economies could pose threats to the territorial integrity and continuity of the state. Measures of organized violence or total battle deaths, common measures of conflict correlations, do not capture these threats to the legitimacy and capacity of the state.

Projections for population security suggest a wide range of human security stresses connected to changes in food and agriculture, water, and health among others. The impacts are due in part to climate change and interact with other population, consumption, and political trends.

The vulnerability of infrastructure in developed and developing countries to extreme weather events and sea level rise is projected to post greater threats as the world continues to urbanize rapidly, often on coasts. Concern is focused on coastal cities and infrastructure. Other specific settings such as energy sector infrastructure constructed on formerly solid permafrost come in for special attention. Spikes and higher anticipated average summer temperatures are also causing concern for nuclear power plants that rely on water for cooling after French nuclear reactors could not use warmer water during the summer of 2003.

As actions taken 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). Some research has identified links between increased biofuels production, food price spikes, and social instability such as riots. The increased deployment of renewable energy technologies that have at times resulted in social conflict and human insecurity (forced resettlement from large hydropower infrastructure projects) is the basis for projections of greater social conflict (McDonald-Wilmsen et al 2010; Conca 2005). 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. Other reports point to an increased use of nuclear power as a factor in the availability of nuclear material that could contribute to nuclear weapons proliferation. Social conflict from buying or leasing land in third countries, an adaptation that increased in part in reaction to high food prices and food export controls of 2008, have contributed to social conflict with upscaled consequences (such as a contributory role to the 2010 Malagasy change in government). The evidence base is limited and largely in the realm of projections in direct response to climate policy actions that are not yet in widespread use for sustained periods.

12.5.4.4. Synthesis: Challenges for the Institutions that Provide Human Security

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) and/or from declines in seasonal snow or glacial melt.

Some common institutional practices have poor fit with challenges posed by complex coupled social ecological systems. The regular practice of organizing interactions on a bilateral state to state basis matches poorly with the upscaling of human security impacts that ignore state boundaries. The disconnections among institutional efforts to address agriculture, water, trade, energy, transport, and health within states and in international forums undercut effectiveness in analyzing and responding to the impacts from coupled biophysical change and social responses.

12.5.5. Adaptation and Managing Risks

12.2.5.1. Evidence on Conflict Management as a Mechanism to Reduce Violence and Insecurity

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. 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).

12.2.5.2. Evidence on Transboundary Cooperation to Reduce Conflict and Enhance Cooperation

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 (rhetorical) and low levels of conflict (rhetorical) Wolf et al, 2003; De Stefano et al. 2010). The evidence suggests only a limited number of overtly violent conflict 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 (no significant harm, 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 stemming from upstream/downstream position, economic power, and/or military power can undercut the 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).

[INSERT TABLE 12-1 HERE
Table 12-1: Summary of the climate change mechanisms and elements of resulting insecurity for selected impacts.]

12.6. Linkages between the Economic, Cultural, Migration, and Conflict Dimensions of Human Security

This section is still to be written. It will seek to distil the scientific literature on the interactions between the major elements of human security, such as the nexus between conflict, migration and resource scarcity. In addition this section will draw on the emerging findings of Chapter 7on food production and food security; Chapter 11 on Human Health, Chapter 13 on Poverty and the regional Chapters to draw out the interactions between elements of human security.

Summary type findings such as presented in initial form in **Table 12.1** will seek to draw out these interaction effects. This section will also seek to synthesize interactions by taking case study regions as Boxes or include them through the Chapter. Candidate issues include human security related to climate change in the Mekong Basin, climate change impacts in the Arctic, or human security affected by resource scarcity in post-conflict societies.

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Table 12-1: Summary of the climate change mechanisms and elements of resulting insecurity for selected impacts.

Issues	**Mechanisms linking climate change to insecurity**	**Elements of insecurity**
Vulnerable livelihoods, poverty and marginalised places	Agricultural productivity and resource decline water availability. Disease burden increased by climate shifts (and water). Transitory poverty and direct risks from extreme events.	Human insecurity (low prospects, unemployment) increases likelihood of young adults joining armed groups (low opportunity costs) in conflict-prone regions. Increased uncertainty about the future increases insecurity.
Capacity of states	Costs of providing public infrastructure increase (water, health and social protection). Macro-economic effects of slow growth, decreased revenues and long-run capacity.	Weakened states have less resources to fulfill social contract and face greater risk of disaffection. Greater impact of climate change in post-conflict societies.
Migration	Resource scarcity changes real economic differentials between rural and urban areas. Displacement as places become economically unviable through disinvestment or direct loss.	Migrants cluster in hazardous areas in cities. Migrant rights and position in labour markets. Significant benefits of migration and mobility in increasing human security through spreading and avoiding risks.

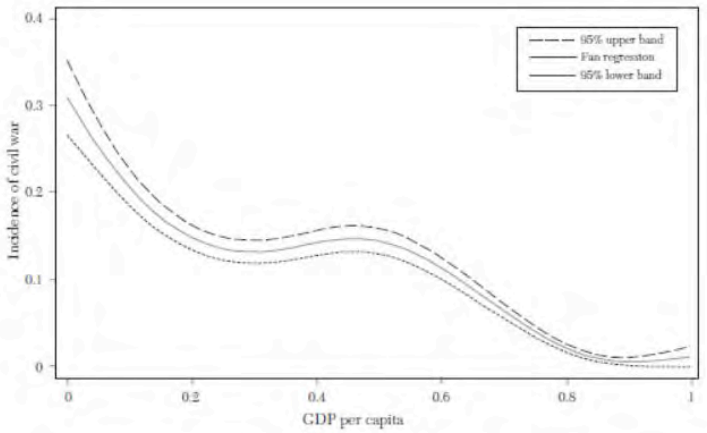

Figure 3: Incidence of Civil War by Country Income per Capita, 1960–2006

Sources: Figure displays the results of a Fan regression of the incidence of civil war on GDP per capita percentiles (bandwidth = 0.3, bootstrapped standard errors). Population and GDP data are drawn from the World Development Indicators (World Bank 2008). Civil war incidence is drawn from the UCDP/PRIO armed conflict database (Gleditsch et al. 2002; Harbom and Wallensteen 2007).

Figure 12-1: Incidence of civil war 1960-2005 related to income per capita (Blattman and Miguel, 2010).