Chapter 13. Livelihoods and Poverty

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Executive Summary

This chapter discusses the concepts of livelihoods, poverty, and inequality, recognizing that poverty and the lives of the poor interact with climate change in multi-faceted and cross-scalar ways. It examines how current and projected impacts of both climate change and responses to climate change affect livelihoods and poverty. The IPCC Fourth Assessment Report stated that poor and marginalized populations are likely to suffer and will continue to suffer disproportionately from the impacts of climate change. The lack of an in-depth assessment justifies this new chapter.

There is ample evidence that poor people's lives and livelihoods are already affected by climate change. Many of the experienced climate impacts, particularly in terms of increased rainfall and temperature variability, are caused by climatic events not easily detected by standard meteorological observations (high confidence).

- Climate change affects poor people's lives directly through gradual shifts in seasonality and extreme weather events and impacts on food production, and indirectly by affecting access to food. [13.2.4, 13.3.1]
- However, many changes may be too subtle to be detected by aggregated (e.g. monthly) observations. [13.3.1]
- Experienced changes are in the form of distribution over time and in magnitude. The time series of climatic observations are often short and/or incomplete and geographically sparse. [13.3.11, 13.3.1.2]

Climate change worsens existing poverty and exacerbates livelihood vulnerability among the poor and marginalized while triggering new vulnerabilities as well as some few possible opportunities. Climate change is *very likely* to constitute an additional burden to the poor and act as a threat multiplier, overlaying deep-seated structural causes of poverty and inequality that shape vulnerabilities (high confidence).

- Not all poor people are equally affected by impacts of climate change, and not all vulnerable populations are poor. The interplay between climatic and non-climatic stressors determines vulnerability. [13.2.1.2, 13.3.1]
- Livelihoods of socially and geographically marginalised persons exposed to persistent inequalities at the inter-section of age, gender, class, and ethnicity are experiencing disproportionate harm from the impacts of climate change. This includes many women, children, the elderly, and indigenous populations. [13.2.3, 13.3.1.5]
- Very scarce evidence exists that demonstrates positive impacts of climate change on the poor. [13.3.1.4]

Climate change is *likely* to create new poor and make many transient poor become chronic poor. This applies to both low-income countries and middle- to high-income countries (high confidence).

- With the rise of poverty and inequality in middle- to higher-income countries, impacts of climate change on the poor have increased, although comprehensive evidence is absent. [13.2.2.3, 13.2.4, 13.3.1.4, 13.3.1.5]
- Shifts from transient to chronic poverty are likely to occur for individuals, households, and populations that face multiple stressors, chronic deprivation, and successive erosion of livelihood assets. [13.2.2.4, 13.3.1.3, 13.3.1.4]

- The large majority of poor people lack effective response options, which puts them precariously close to poverty traps, while more affluent and powerful groups may benefit from climate change and policy responses. [13.3.1.5]

Future impacts of climate change will *likely* slow down the pace of poverty reduction in rural and urban areas across the globe, further erode food security, and jeopardize sustainable development (high confidence).

- Poor countries are expected to experience even greater poverty as a result of future climatic changes, including large proportions of the urban poor in developing countries shifting into chronic poverty. [13.3.2.1, 13.3.2.2]
- Most of the world's poor will live in lower middle-income countries while new poverty pockets emerge in high-income nations, posing new challenges to dual climate change and development solutions. [13.2.2.3, 13.3.2]
- Without good governance, there is a risk that climate change response mechanisms promoted as development strategies may exacerbate inequality and multi-dimensional deprivation. [13.3.3]

Policy responses aimed at climate change mitigation or adaptation *are likely* to result in mixed albeit often detrimental consequences for poor and marginalized populations (medium to high confidence).

- Mitigation efforts such the CDM, REDD+, and land acquisition for food and biofuel production have shown mostly negative impacts, often concentrated among marginalized groups in poor countries. [13.4.1]
- Insurance schemes and social protection programs have the potential to reduce poverty, strengthen adaptive capacities, and enhance livelihood resilience among vulnerable and marginalized populations. [13.4.2, 13.5]
- Climate change mechanisms such as the CDM or REDD+ will only have marginal effects on poverty reduction unless the conditions that underlie poor people's marginalization are radically altered. [13.4.1, 13.6]

13.1. Scope, Delineations, and Definitions: Livelihoods, Poverty, and Inequality

A better understanding of the impacts of climate change on livelihoods and poverty requires an examination of the complexities of poverty and the lives of the poor as well as the multi-faceted and cross-scalar intersection of poverty and livelihoods with climate change. This chapter covers three overriding issues. First, it discusses the concepts of livelihoods, poverty, and inequality, as well as the interaction of these three under climate change and emerging threats and opportunities. This section presents the multiple interlinkages and complexities, and structural causes of poverty and inequality that shape climate change impacts. Second, it describes current evidence and expected future impacts of climate change on livelihoods and poverty. Impacts considered include both gradual change and extreme events, on urban and rural poor, in low- and middle- to high-income countries. Third, it discusses the impacts of climate change responses on livelihoods and poverty. This part addresses whether responses such as local to national and international policies and measures aimed at climate change mitigation and/or adaptation (e.g., CDM and REDD initiatives insurance instruments,) reduce or further increase harm among poor and marginalized populations.

Livelihoods are typically understood as the ensemble of capabilities, assets and activities that are required for a means of living (Chambers and Conway, 1992; Ellis *et al*., 2003). Livelihoods depend on access to natural, human, physical, financial, social, and cultural capital (assets); the ways in which people combine and transform these assets; the ways people expand their asset base through relationships with other actors; and the ways in which they deploy and enhance their capabilities to be and to act, to make lives meaningful, and to negotiate the rules that govern the control, use, and transformation of resources (Bebbington, 1999; Scoones and Institute of Development Studies, 1998). Livelihoods are dynamic, often pieced together in an attempt to adapt to and change with internal and external stressors, yet their ultimate purpose is to transform assets into income, dignity, and agency that improve living conditions.

Some livelihoods are directly climate-sensitive, such as smallholder agriculture, seasonal employment in agriculture (tea, coffee, sugar), fishing, pastoralism, and forest dwellers. However, non-resource dependent livelihoods including urban wage laborers and populations in slums and other informal urban settlements can be equally impacted by climate change, both directly through unsafe settlement structure or indirectly through rises in food prices. Moreover, children- and female-headed households and other marginalized populations often suffer multiple deprivations and inequalities that make them particularly vulnerable to climatic and other stressors rather than through their livelihoods *per se*.

Poverty is a complex concept with several and conflicting definitions. We acknowledge the multi-dimensionality of poverty and stress multiple deprivations as most limiting in the pursuit of well-being and responses to climate change impacts. Poverty and multiple deprivations explain how people's livelihoods are exposed and vulnerable to climatic and other stressors. In addition, an understanding of inequality illustrates the reasons why poor people remain in risky or unsustainable livelihoods, often despite poverty reduction and human development efforts. Poverty is a state in which people do not have enough power to voice their concerns and interests and thereby are often excluded from many decision making processes. It is crucial to recognize such marginalization in relation to climate change mitigation and adaptation policies, adaptive capacity, social resilience, and societal transformations.

A number of approaches exist to define poverty, yet there is considerable disagreement in terms of framings, methodologies, and measurements. Different approaches emphasize different aspects of poverty, either at the individual or collective level, including monetary features and accounting methods; capabilities, quality of life, and human development; well-being; social exclusion; and participation and other procedural dimensions (Laderchi *et al*., 2003). As a counterweight to the income-based poverty measures, the main alternative approaches highlight the relational aspects of poverty (Alkire and Foster, 2011; Chen and Ravallion, 2012; Sen, 1976; UNDP, 2011b) and focus on inequality and social protection (Deacon and Cohen, 2011; Haarstad and St Clair, 2011; UNRISD, 2010).

This chapter examines linkages and gaps between these various approaches as well as their efficacy to responding to the needs of the poor under a changing climate. In addition to poverty in low-income countries, there is a growing concern about rising poverty and income inequality in middle- and high- income countries (Gower et. al., 2012; OECD, 2011). This chapter aims to assess climate change impacts on livelihoods and poverty by acknowledging structural causes of persistent poverty and inequalities, and the complex intersections of climate change with other stressors. Finally, it describes the limitations of our understanding between climate change, livelihoods, and poverty.

13.2. Livelihoods, Poverty, and Inequality: Salient Features

This section provides a succinct overview of the salient features of livelihoods, poverty and inequality, as well as the interfaces between these features and climate change. It first describes the dynamics of livelihoods in managing assets and capabilities and the various stressors livelihoods face and respond to, only one of which is climate change. The section then explores the different dimensions of poverty, including its diverse and often contradictory framings, measurements, its geographic distribution, and spatial and temporal scales. Third, it explains how inequality and marginalization perpetuate multi-dimensional poverty, with particular attention to gender and indigenous people. Finally, it shows how livelihoods, poverty, and inequality interact with climate change.

13.2.1. Livelihoods

The concept of livelihoods revolves around the opportunity set afforded by an individual or a household, as defined by their asset endowments and their chosen allocation of those assets across various activities to generate a stream of benefits (Barrett *et al*., 2001). Livelihoods are often viewed as the main vehicle to satisfy basic human needs. Individual capabilities are crucial for enhancing people's ability to be agents of change, a prerequisite for poverty alleviation (Sen, 1981). Yet basic needs, livelihoods, and capabilities, particularly among poor and disenfranchised populations, are increasingly threatened and eroded by the adverse impacts of climate change and variability, and compounded by other, non-climatic stressors (Adger, 2010; Leary, 2008; Quinn *et al*., 2011; UNDP (United Nations Development Programme), 2007).

13.2.1.1. Dynamic Livelihoods

A livelihood lens is advantageous for examining dynamic decision-making under climatic and other stressors and identifying processes that may force poor and vulnerable people onto undesirable trajectories, trap them in destitution, or provide escape routes toward enhanced well-being. It allows a multidimensional and grounded

analysis of people's "messy" lives by recognizing the flexibility, or lack thereof, with which they draw upon different asset bases and capabilities to construct their livelihoods, in particular communities and places. An understanding of the dynamics of livelihood strategies of individuals and households requires an explicit focus on the wider institutional, cultural, and policy context in which livelihoods are embedded as well as shocks, seasonality, trends, and changes that they experience. A key process is livelihood diversification: diversifying activity portfolios and social support capabilities to spread risks and enlarge opportunities by juggling different types of assets with the goal of improving livelihood outcomes and standards of living (Batterbury, 2001; Ellis *et al*., 2003). The sustainable livelihoods framework (Chambers and Conway, 1992) is powerful for assessing the complexities that surround poverty and the lives of the poor, although it has been criticized for not sufficiently explaining the wider structural processes that constrain livelihoods and well-being (Scoones, 2009). It allows for identifying specific strategies into economic activities that may lead to livelihood improvements or a vicious cycle of impoverishment and the critical thresholds beyond which a certain livelihood is radically transformed (Sabates‐Wheeler *et al*., 2008).

13.2.1.2. Multiple Stressors

Livelihoods rarely face just one stressor or shock at a time. The literature emphasizes the synergistic relationship between climate change as one stressor and a variety of other environmental, social, and political stressors that impinge on livelihoods and well-being and reinforce each other in the process, often negatively (Eakin and Wehbe, 2009; Eriksen and Silva, 2009; IPCC, 2007; O'BRIEN *et al*., 2008; Reid and Vogel, 2006; Schipper and Pelling, 2006; Tschakert, 2007; Ziervogel *et al*., 2010). These include market volatility, changing land tenure systems, rapid urbanization, spread of infectious diseases, declining soil fertility, and poor or absent public services. Climate risks and market integration ('double exposure') are together exacerbating the economic marginalization of vulnerable groups while providing opportunities to others (Eriksen and Silva, 2009; O'Brien and Leichenko, 2000). Climatic and other stressors affect livelihoods at different spatial and temporal scales. Impacts, both direct and indirect, are often amplified or weakened when moving from one scale to another. Many of the stressors felt locally are generated through global or regional processes and interact with national and local processes and relations (Paavola, 2008; Pouliotte *et al*., 2009; Reid and Vogel, 2006; Thomas *et al*., 2007).

Multiple and successive stressors differentially shape livelihood dynamics and trajectories. More affluent households may be able to capitalize on shocks and crises while poorer households with less flexible and productive asset portfolios tend to erode their asset bases. Weak institutional ties and power positions, often the case for women and other marginalized groups, further restrict effective livelihood responses (Eriksen and Lind, 2009; Eriksen *et al*., 2005; Gotschi *et al*., 2008). Some coping strategies and autonomous adaptation result in adverse consequences that undermine the long-term sustainability of livelihoods, indicate barriers and limits to adaptation, and result in downward mobility, further impoverishment, and poverty traps (Barnett and O'Neill, 2010; Ziervogel *et al*., 2006). Increasingly, attention is put on 'feasible solution spaces' for dealing with multiple stressors (Field et. al., 2012).

13.2.2. Dimensions of Poverty

Poverty is multi-faceted and characterized by cultural, social, institutional, political, and religious drivers. It is reflected in food insecurity, uneven and inadequate access to markets, health facilities, and other basic services such as schools, poor urban infrastructure and slum settlements, and resource inequality between rural and urban areas. In addition to material deprivation, poverty encompasses dimensions of belonging, socio-cultural heritage, and control over one's destiny (O'Brien and Leichenko, 2003). Yet, despite its complexity, many poverty assessments remain restricted to the predominant facet of income, or a combination of the Millennium Development Goals (MDGs), disregarding poverty's other dimensions and dynamics. This makes measuring climate change impacts challenging.

13.2.2.1. Framings

The way poverty is framed, understood, and incorporated into policy decision-making is essential for assessing the complex direct and indirect impacts of climate change on poverty and the individual and structural response options

that are proposed. In climate change debates, poverty and poverty reduction have been predominantly defined through an economic lens. Just as climate change itself, poverty reduction is largely seen as a technical issue best solved through economic growth and external and expert-led policy decision-making. "Mitigation, adaptation, and the deployment of technologies have to happen in a way that allows developing countries to continue their growth and reduce poverty" (World Bank, 2010). Such framing reflects key development discourses, including the balanced growth approach ("The Big Push") emphasizing foreign aid and large-scale infrastructural investments (Rosenstein-Rodan, 1943; Sachs, 2006) and smaller-scale initiatives led by private actors following an unbalanced growth model (Easterly, 2006; Hirschman, 1988). Targeted are "The Bottom Billion," approximately one billion persons living in the 58 poorest countries of the world defined by persistent economic growth stagnation (Collier, 2007) and those living in extreme poverty (by World Bank standards, <$1.25/day), unable to sustain significant economic growth (Sachs, 2006). Most policy prescriptions favor market-based responses and adaptation aid to counter undesirable trends that are *likely* to slow down or even threaten the achievements of the MDGs. This includes sector-specific and economic growth models that estimate climate impacts on the world's poor.

Alternative poverty discourses acknowledge poverty as relational, constructed in particular places in relation to wealth and privilege. Drawing upon the capabilities approach (Alkire, 2005; Anand *et al*., 2005; Nussbaum, 2001; Nussbaum, 2011; Sen, 1999; Sen, 1985), they place the needs, skills, aspirations, and agency of poor people at the center of analysis while tackling deep-seated structural causes of poverty, inequalities, and uneven power relations. Contrary to the technocratic and heavily market-driven development solutions under neo-liberal policies that typically construct the poor as a category outside of social relations, this relational framing of poverty promotes human dignity and security, a culture of solidarity, and the responsibility to protect, to foster resilience and capacity to act and to combat inequality (Gasper, 2010; Lawson and Clair, 2009; O'Brien *et al*., 2010; Pogge, 2009; UNRISD, 2010). Such a framing allows for addressing not only the adverse outcomes of climate change but also the social and political context that generates both vulnerability and poverty (Bandiera *et al*., 2005; Leichenko and O'Brien, 2008; McCright and Dunlap, 2000).

13.2.2.2. Measuring Poverty

The most common contemporary measures of poverty focus on a poverty line, defined with reference to income or nutritional levels, or access to a basket of goods and services. Measurements since the 1970s include non-income characteristics such as longevity, literacy, good health, adaptive capacity, ability to make choices, and access to opportunities and power. Today, poverty is recognized as multi-dimensional (UNDP, 1990), including social, cultural, and political forces, requiring efforts to reverse it in multiple domains and dimensions by promoting opportunities, facilitating empowerment, and enhancing security (World Bank, 2001). Increased attention to chronic poverty has shifted the analytical lens to the dynamics of poverty and its institutionalization within social and political norms. The Chronic Poverty Report 2008-2009 (Chronic Poverty Research Centre, 2008)illustrates how millions of people become trapped in poverty for most of their lives. Understanding the causes of movements in and out of poverty can provide a sounder basis for strategies to eradicate poverty than conventional analyses of national poverty (McKay and Lawson, 2003)(Hulme and Shepherd, 2003). Efforts are made to understand multidimensional deprivation – hunger, illiteracy, unclean drinking water, lack of access to health services, sanitation, and electricity, and social isolation (WHO (World Health Organization), 2006).

Yet, the technical literature has faced difficulties in producing compelling metrics that capture the complexity of poverty. Absolute poverty, characterized by "severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information" (UN, 1995) allows comparisons across regions while relative poverty measures compare people within the same population. The key yardstick for tracking poverty head counts and progress on the Millennium Development Goals (MDGs) remains the International Poverty Line (IPL), currently set at $1.25/day. However, the IPL disregards how far above or below this line people live (intensity of poverty) and how poverty is distributed within a country, thus concealing major inequalities. Also, it does not query the statistical assumption between economic growth and poverty reduction (Vandemoortele, 2009).

To date, progress toward the MDGs shows mixed results. At a global level, indicators for the key seven MDGs (income poverty, primary completion, gender equality in education, nutrition, child mortality, maternal mortality,

and water) have all improved since 1990. However, at a country level, only half of all countries are 'on-track' for income poverty, education, gender, and water, and even less for nutrition, child and maternal mortality (Table 13-1). For instance, while the proportion of underweight children under 5 years of age has decreased across all regions of the world since 1990, progress in Southern Asia and sub-Saharan has been slower. In sub-Saharan Africa, the mortality rate remains above one in 10, nearly 20 times the number of deaths experienced in developed countries. Moreover, there are considerable disparities across nutrition and health data, particularly across urban-rural estimates and in outcomes between national averages and the poorest (UNICEF, 2010). Gender differences are more complex, reflecting both higher under-five mortality for boys, except for Asia, and higher illiteracy rates among adolescent girls (UNICEF, 2011). Across 15 member states of the Southern African Development Community (SADC), only three were below 0.50 on the Gender Equality Index and only one below 0.4, with an index of zero indicating highest equality (UNDP, 2011a). The number of people living between $1.25 and $2 has almost doubled from 648 million to 1.18 billion between 1981 and 2008 (World Bank, 2012).

[INSERT TABLE 13-1 HERE
Table 13-1: Progress toward the MDGs, globally and at the country level.]

The recent UNDP Multidimensional Poverty Index (MPI) attempts to measure intensity of poverty based on patterns of deprivations in rudimentary services and core human functionings (Alkire and Santos, 2010). It allows for an understanding of deprivations that affect a household simultaneously, and emphasizes the spatial distribution and clustering of poverty. By comparing three dimensions – health, education, and standard of living – the MPI reveals the greatest intensity of poverty to be present in 29 African and four South Asian countries and in Haiti and Yemen. It indicates that 1.7 billion people are poor when the multidimensional nature of poverty is taken into account, a far higher number than indicated by the $1.25/day IPL. Emerging patterns point towards differential driving forces, e.g. nutritional deprivation versus ill health. Other recent work illustrates decomposition by a country's administrative units, spatial distributions of poverty, and distance from reaching a poverty line (CIESIN, 2006).

[INSERT FIGURE 13-1 HERE (placeholder)
Figure 13-1: Global distribution of poverty (MPI) as a world map, with other poverty measures; incl. a poverty gap analysis = mean shortfall of the total population from the poverty line (counting the nonpoor as having zero shortfall), expressed as % of the poverty line (reference needed) and illustrating trends over space and time.]

13.2.2.3. Geographic Distribution and Trends of the World's Poor

In 1990, most of the world's $1.25 poor (93%) lived in low income countries (LIC) where the average income was barely above the international poverty line. However, the majority of the world's poor (>70%) now live in countries classified by the World Bank as lower middle-income countries (MIC) where average income is generally much higher than the poverty line (Sumner, 2010; Sumner *et al.*, 2012). Multidimensional poverty, malnutrition, and the global disease burden are also concentrated in this lower MIC group (Alkire *et al.*, 2011; Glassman *et al.*, 2011). The regional distribution of global poverty is shifting towards South Asia and sub-Saharan Africa. Almost 30 countries attained MIC classification by 2010, reducing the number of LICs from 63 in 2000 to 35 (Moss and Leo, 2011). Yet, the world's poor are surprisingly concentrated: 80% of the world's extreme ($1.25) poor live in just 10 countries, including several that graduated to lower MIC status such as India, Indonesia, and Nigeria (Sumner *et al.*, 2012). When one removes China from the global poverty data, $1.25 poverty has barely fallen and remains around 1billion people and $2 poverty has remains around 2 billion people (Chen and Ravallion, 2012). Global poverty is largely rural (IFAD, 2011) and yet, globally, populations are becoming largely urban centered (UN Habitat, 2010).

The changing distribution of global poverty towards MICs challenges the orthodox view that most of the world's extreme poor live in the world's poorest countries (by average per capita income), and it suggests that substantial 'pockets' of poverty can persist at higher levels of average per capita income. This has potential implications for the poverty impacts of climate change at various levels. First, climate finance is directed towards LICs were most of the world's poor do not live anymore. Second, more attention is needed to understand climate impacts and vulnerabilities in MICs. By 2030, the global distribution of poverty will change further so that most of the world's poor will live in middle-income sub-Saharan Africa, where livelihood impacts are particularly probable.

13.2.2.4. Spatial and Temporal Scales of Poverty

Empirical evidence points toward the need to understand the scalar dimensions of poverty and livelihood trajectories over time as critical factors in assessing impacts of climate change and responses to design effective policy support structures (Sabates‐Wheeler *et al.*, 2008). A spatial lens allows for tracking cross-scalar processes – from individuals to households and communities to countries and the international level – that perpetuate poverty and inequality and those that contribute to poverty reduction, including power relations, access to and control over resources, resource accumulation, and vertical and horizontal institutional linkages and social structures (Anderson and Broch-Due, 2000; Murray, 2002; O'Laughlin, 2002; Rodima-Taylor, 2011). Poverty and vulnerability can be nested and teleconnected, masking local to regional impoverishment triggered across large geographic distances (Eakin *et al.*, 2009). Moreover, poverty is socially stratified, meaning that not everybody is poor in the same way. Even at the household level, differential poverty between men and women and different age groups is expected to be widespread, yet a systematic analysis is currently not possible to due data constraints (Alkire and Santos, 2010).

A temporal lens allows for distinction between transient and chronic poverty (Sen, 1981; Sen, 1999). Chronic poverty describes an individual deprivation, per capita income, or consumption levels below the poverty line for a long time (Gaiha and Deolalikar, 1993; Hulme and Shepherd, 2003; Jalan and Ravallion, 1998; Jalan and Ravallion, 2000). It is often associated with absolute poverty, characterized by lack of human capital, lack of ownership of physical assets, the demographic composition of households, and low-paid jobs (McKay and Lawson, 2003). Transient poverty denotes a temporary state of deprivation and is frequently triggered by an individual's or household's inability to maintain income or consumption levels in times of shocks or crises (Jalan and Ravallion, 1998), resulting in seasonality of hunger and poverty. State dependence explains the relationship between previous deprivation and proneness to poverty over successive time periods (Giraldo *et al.*, 2002), stressing the need to monitor trends rather than snapshots in time.

Individuals and households can fluctuate between different degrees of poverty and shift in and out of deprivation, vulnerability, and well-being (Leach *et al.*, 1999; Little *et al.*, 2008; Sallu *et al.*, 2010). Poor people often get trapped in poverty traps – situations in which escaping poverty (cross the poverty line) becomes impossible due to unproductive or inflexible asset portfolios (Barrett and McPeak, 2006). A poverty trap can also be seen a "critical minimum asset threshold, below which families are unable to successfully educate their children, build up their productive assets, and move ahead economically over time" (Carter *et al.*, 2007). To Sachs (Sachs, 2006), extreme poverty is itself a trap, since poor persons lack the capital to participate meaningfully in the global market economy. Other examples of poverty traps, at national scales, include the "natural resource curse" (Auty, 2004; Collier, 2007; Hinojosa-Valencia *et al.*, 2012; Le Billon, 2001), denoting diminishing governmental accountability (Khoday and Perch, 2012) while corruption and political violence increase in the case of abundant oil or other valuable natural resources, as well as persistent armed conflict in poor countries (Collier, 2007; Rice *et al.*, 2006; Smith and Vivekananda, 2009), mainly due to reduced national trade and foreign investment, and poor governance (Collier, 2007; Sachs, 2006).

13.2.3. Inequality and Marginalization

The fact that the poor and minority people experience and will continue to suffer disproportional harm from climate change impacts is well established (Adger et al., 2007; Brody *et al.*, 2008; Kates, 2000). Inequality is a useful lens for examining why multi-dimensional poverty continues to exist, and in some cases has increased, despite persistent efforts to reduce poverty. Persistent inequalities in access to and control over resources and the uneven power structures that sustain them are systematically related to indigenous and minority status, gender, race, class, ethnicity, and disability, and are at the core of structural causes of poverty and socially-differentiated vulnerability (Field et. al., 2012; Sen, 1999). They not only inhibit the poor and marginalized from managing daily risk and effectively coping with climatic and non-climatic shocks (Ayers and Huq, 2009; Barnett and O'Neill, 2010; Boyd and Juhola, 2009; Eriksen and O'BRIEN, 2007; O'Brien *et al.*, 2010; OECD, 2011; Petheram *et al.*, 2010), they also represent significant barriers to escape poverty and enjoy a life in dignity.

Global inequality is a persistent phenomenon. In 2007, the top quintile of the world's population received 83% of total world income whereas the bottom quintile took in exactly 1% (Ortiz and Cummins, 2011). Similar to Collier (Collier, 2007), Ortiz and Cummins (Ortiz and Cummins, 2011) argue that inequality itself inhibits economic growth, taking the bottom billion 272 years to achieve 10% of global income under rates adjusted for PPP. UNDP (UNDP, 2011a) states that, although health and educational achievement gaps have narrowed, income inequality has increased in most countries. UNRISD (UNRISD, 2010) illustrates that economic activity and growth is often restricted to certain economic sectors in highly unequal countries, which constrains the productive capacity of the poor. Furthermore, the bottom income groups in unequal countries are far more *likely* to bear the externalities of economic growth, such as environmental degradation (UNDP, 2011a; UNRISD, 2010). A focus on inequality also highlights growing poverty in middle- and high-income countries, comparing the role of social protection, as well part of climate change responses, under the welfare state model with neo-liberal policies (Gough, 2012).

Socially and geographically marginalized populations around the world, often at the intersection of gender, class, caste, ethnicity, and age, including indigenous people, women, children, the elderly, and disabled people, are particularly vulnerable to climatic risks and other stressors due to the underlying patterns of inequality that hinder effective preparation and responses. For instance, data for the U.S. highlights significant disparities along ethnic and racial lines (Lewis *et al.*, 2010), particularly in relation to access to critical services. According to an assessment of financial fragility in the U.S., almost 50% of persons surveyed would not be able to come up with an extra USD 2,000 in 30 days for an emergency, and 1/5 would need to pawn or sell possessions to do so (Lusardi *et al.*, 2011). Indigenous peoples, comprising 350 million persons of 5,000 different groups in more than 70 countries (Davis, 2010) experience persistent exclusion and devaluation of their values and connections to place and landscapes, lack of voice, and miscommunication, perpetuating their disempowerment (Davis, 2010; Petheram *et al.*, 2010; Schroeder, 2010). The compounded effect of continued marginalization of indigenous and other minority people and low recognition of their rights, mirrors concerns about the "systematic undervaluation of involuntary loss of places and culture" that also constitutes a critical limit to adaptation (Adger *et al.*, 2009).

In terms of gender inequality, significant gaps remain, despite important improvements in women's lives over recent decades. The World Bank (World Bank, 2012) reports that 3.9 million women from birth to age 60 are "missing" due to higher mortality rates compared to men in low- and middle-income countries. Specific configurations of uneven social relations of power, social and cultural norms that determine division of labor, inequality in economic and political positions, and discriminatory institutional practices all shape unequal gendered access to and control over household and community decision-making processes (Carney, 1996; Jackson, 1993; Kandioti, 1998; Rocheleau *et al.*, 1997). These factors, in turn, result in gender-differentiated impacts of climate change (Aguilar, 2007; Dankelman, 2008; MacGregor, 2010; Resurreccion, 2011; Terry, 2009; UNFPA, 2009; Williams, 2010).

13.2.4. Interactions between Livelihoods, Poverty, Inequality, and Climate Change

More than any other factors, poverty and persistent inequalities determine vulnerability to climate change as well as opportunities for adaptive action. Poverty and inequality mean that people have few livelihood assets to fall back on in times of hard-ship, including little savings and limited access to credit (Mearns and Norton, 2010). Unsustainable short-term coping strategies as well as longer-term adaptive action in response to incremental changes, heightened variability, and extreme events such as droughts, floods, and extreme temperatures can erode assets and lead to poverty traps. Poor and marginalized people typically have the least buffer to face even modest changes of climate hazards and suffer most from successive events that provide little time for recovery. They are the first to experience barriers and limits to adaptation. There is a bi-directional relationship between climate change and poverty. Climate change is *very likely* an additional burden to the poor; it is also *likely* to create new poor and forces some poor from transient into chronic poverty. Addressing the structural inequalities that create and sustain poverty is vital for both climate change adaptation and development (Boyd and Juhola, 2009; Huq *et al.*, 2005; Lemos *et al.*, 2007; Schipper, 2007; Williams, 2010) (Perch, 2011). Ignoring uneven social relations that burden the poorest disproportionately with the brunt of negative impacts of climate change is a key factor of maladaptation (Barnett and O'Neill, 2010).

It is essential to highlight the complex interactions between climate change, dynamic livelihoods, multi-dimensional poverty and deprivation, and persistent inequalities across temporal and spatial scales. It is the intersection of these multi-faceted elements that provides an ever shifting context of risk and makes certain people vulnerable to stressors and shocks. Climate variability, gradual climatic changes, and extreme events synergistically add on to and often reinforce other environmental, social, and political calamities. A focus on multiple deprivations explains how and why people's livelihoods are vulnerable. For instance, in the Caribbean Small Island Development States (SIDS), poverty is more broadly defined in terms of real 'living conditions' – social vulnerability that exemplifies the nexus of low economic well-being, poor health, housing in disaster-prone areas, and female-headed households (Kambon, 2005; Perch and Roy, 2010). Multiple deprivations interact with each other to create conditions for chronic poverty.

Attention to livelihood dynamics that interact with climate stressors allows for identifying processes that force poor and vulnerable people onto undesirable trajectories, trap them in chronic poverty and destitution, constitute critical thresholds beyond which a certain livelihood is no longer feasible, or offer transformative routes toward enhanced well-being. Figures 13-2 illustrates some of these complexities, both in impacts and analysis. While rich evidence exists of differential impacts on livelihoods and particular dimensions of poverty, there is a paucity of data that show the complexity of impacts, gradual shifts over time, critical thresholds, and abrupt changes in coupled social-ecological systems, and factual poverty traps. Yet, these are central for defining solutions to eliminate poverty.

[INSERT FIGURE 13-2 HERE
Figure 13-2: Livelihood dynamics under increasing frequency and severity of climatic stressors combined with unequally distributed socio-economic stressors, leading to differential trajectories (pos. transformation and traps).]

This chapter is an important contribution in this direction. It reveals, through a systematic review of the literature, why a thorough understanding of livelihood and poverty dynamics across spatial and temporal scales is vital to bring to light the highly unequal impacts of climate change. It builds upon new insight from the 2012 SREX that highlight "addressing the underlying causes of vulnerability, including the structural inequities that create and sustain poverty and constrain access to resources" as "a prerequisite for sustainability in the context of climate change" (Field et. al., 2012). Acknowledging the changing distribution of global poverty towards MICs (Sumner, 2010; Sumner *et al.*, 2012) and rising poverty and income inequality in middle- and high- income countries (Gower et. al., 2012; IEA (International Energy Agency), 2011), this chapter opens its analytical lens from a conventional focus on poor developing countries being the prime victims of climate change to a broader understanding of inequalities across the globe that determine climate change impacts, today and in the future, as well as the impacts of climate change policies designed to correct uneven outcomes.

13.3. Assessment of Climate Change Impacts on Livelihoods and Poverty

This section is a systematic review of empirically-found relationships between climate change on the one hand and livelihoods and poverty on the other. It first describes current and observed impacts (13.3.1.) and then future and projected impacts (13.3.2.). By focusing explicitly on effects on assets and livelihood dynamics, it demonstrates how climate change interacts with multiple stressors people face. It also highlights the mechanisms by which climate change impacts trigger shifts from transient to chronic poverty, and contribute to the creation of poverty traps and livelihood transformations. Finally, it assesses implications for sustainabilty, development, and justice (13.3.3).

13.3.1. Evidence of Observed Climate Change Impacts on Livelihoods and Poverty

Climate change is already taking place, and further changes are inevitable. These include gradual changes in temperature and sea level but also increased climate variability and extremes, including more intense floods, droughts, and storms. They are already having major impacts on the economic performance of developing countries and on the lives and livelihoods of millions of poor people around the world. Even minor changes in precipitation, in terms of amount and distribution in time, as well as short periods of extreme temperatures, can have serious impacts on livelihoods. Many of these climatic events remain 'hidden', not captured by standard climate observations, typically reported as means or accumulations over a month, a season, or a year (Barron *et al.*, 2003; Salack *et al.*,

2012; Tennant and Hewitson, 2002; Usman and Reason, 2004). At the same time, little analysis captures the combined effect of multiple events in a given year, such as 46 events in Haiti and 41 in the Dominican Republic between 1990 and 2009 (Perch, Forthcoming). This difficulty in observation and attribution is compounded by a lack of continuous and dense networks of climate data in many low-income countries.

There are several geographic areas where climate change has direct impacts on poverty, although higher impacts do not necessarily equate with higher vulnerabilities. Of particular concern are regions with high vulnerability due to exposure to sea-level rise and extreme events overlaid with high concentrations of multi-dimensional poverty, including pockets of poor people in middle-income countries. These include mega-deltas in Bangladesh, Thailand, Myanmar, and Vietnam (Eastham *et al*., 2008; Wassmann *et al*., 2009); major rivers emanating from the Himalayas (Xu *et al*., 2009); many river deltas (85%) in the world subject to removal of oil, gas and water from the ground (Syvitski *et al*., 2009), and marginalized coastal areas such as those in eastern and southern Africa, also experiencing severe deterioration of ecosystem resources (Bunce *et al*., 2010a; Bunce *et al*., 2010b). Sea level rise may be most detrimental in countries like Vietnam, Egypt, and Mauritania where 8-10% of the population and 6-10% of the GDP are at risk (Dasgupta *et al*., 2007) and the Philippines and Indonesia, two new MICs with high poverty numbers. In the Caribbean SIDS, the estimated costs of just one hurricane season (2004) on national GDP ranged from 4.5% in Haiti to 212% in Grenada (Kambon, 2005). South East Asia experiences the combined effects of climate change impacts, deep poverty, and large disparities between the rich and the poor (Jasparro and Taylor, 2008). Among the top three countries in terms of poverty head counts, Nigeria's extreme poor (<$1.25/day) have increased by 40% in less than 20 years to now > 100 billion, many of them in the semi-arid north and urban slums (Sumner *et al*., 2012). China counts roughly 400 million of people living on $2/day and India twice as many (Sumner *et al*., 2012). The high Arctic, although less densely populated, has a significant record of climate change impacts on traditional fishing and hunting livelihoods. The coincidence of poverty pockets in high-income nations with extreme events has been most explicit under Hurricane Katrina in the U.S. (Bullard and Wright, 2009; Colten *et al*., 2008; Verchick, 2010), the European heat waves affecting elderly residents (Vandentorren *et al*., 2006), and poor farmers under the Australian drought.

13.3.1.1.Impacts on Livelihood Assets and Human Capabilities

Climate change and its consequences interact with numerous aspects of people's livelihoods, including their assets, their capabilities, and the strategies they undertake to cope with a multitude of other stressors, often amplifying the impacts of climate change. There is abundant evidence in the literature that people's assets (natural, physical, financial, human, social, and cultural) have already been eroded by climate change. Some data exist that show how people's capabilities have been undermined. Examples of livelihood asset accumulation in relation to climate change are comparatively rare. This section presents empirical evidence of impacts on six types of assets.

Impacts on *natural assets* such as water, fish stocks, land, and livestock, are well documented (ActionAid, 2006; Bunce *et al.*, 2010a; Bunce *et al.*, 2010b; D'Agostino and Sovacool, 2011; Nelson and Stathers, 2009; Osbahr *et al.*, 2010; Thomas *et al.*, 2007). Water-scarce regions such as the Middle East and North Africa (MENA) experience dwindling water resources due to climate change, combined with steep increases in demand due to population and economic growth. This is resulting in rapidly decreasing water availability per person, expected to be 30-70 % less in 2025 (Sowers *et al.*, 2011). Water scarcity and drought have also been noted for many Caribbean states and sub-Saharan Africa (IFAD, 2011). Under increasing water scarcity, policy allocation often favors more affluent urban consumers, in MENA (Sowers *et al.*, 2011), the Andes and Himalayas (Orlove, 2009), and Australia (Alston, 2011), at the expense of less powerful rural and/or poor users. Similar reports exist from the Caribbean region (Cashman *et al.*, 2010). It also is an almost universal problem in cities (Satterthwaite, 2011).

Fisheries have also been affected by changing river and lake dynamics due to climate change, often in combination with other human influences (Keskinen *et al.*, 2010; Nuorteva *et al.*, 2010; Palmer *et al.*, 2008). In Lake Tanganyika, for instance, increasing water temperatures and decreasing winds are responsible for a 20% decrease in primary production, implying a 30% decrease in fish yields. This exceeds the effects of overfishing and other human impacts (O'Reilly *et al.*, 2003). Climate change also affects marine fisheries (Badjeck *et al.*, 2010). Many of the poorest countries are highly dependent on fishing as both subsistence and national economic activities, including Senegal,

Guinea, Malawi, and Uganda in Africa, Peru and Colombia in South America, and Bangladesh, Cambodia, Pakistan, and Yemen in Asia (Allison *et al.*, 2009)and the Caribbean (KUSHNER *et al.*, 2011). Ocean acidification also poses serious threats to fisheries in high-income countries, including the U.S. and Scandinavia (Cooley and Doney, 2009).

The most extreme form of erosion of natural assets is the complete disappearance of people's land in low lying islands and coastal regions (McGranahan *et al.*, 2007; Perch and Roy, 2010; Solomon *et al.*, 2009). Nevertheless, persistent inequalities result in differential impacts on the poor and rich. In the Maldives, for instance, islands with tourism development have low incidence of poverty (3%) and access to financial resources for building protective infrastructure while other islands show high incidence of poverty (30%) with few resources for adaptive responses (Sovacool, 2012). While having received less attention, densely populated coastal cities with high poverty counts such as Cotonou in Benin (Dossou and Glehouenou-Dossou, 2007), Alexandria and Port Said in Egypt (El-Raey *et al.*, 1999), and Lagos and Port Harcourt in Nigeria (Abam *et al.*, 2000; Fashae and Onafeso, 2011) are at risk. The Mekong River Delta, the Limpopo River, and Inner Mongolia prepare for resettlement (de Sherbinin *et al.*, 2011).

There is abundant evidence of climatic change eroding farming livelihoods, especially among subsistence farmers and herders around the globe. This includes declining crop yields (Alston, 2010; Apata *et al.*, 2009; Ford *et al.*, 2007; Hassan and Nhemachena, 2008; Pouliotte *et al.*, 2009; Pradhan *et al.*, 2007; Renton, 2009; Sissoko *et al.*, 2011), sometimes as a result of pathogens and insect attacks (Byg and Salick, 2009), as well as reduced availability of and access to non-timber forest products (Hertel and Rosch, 2010) and other eco-system services such as biodiversity and medicinal plants (Van Noordwijk, 2010). Livestock, of high importance in most smallholder agriculture, particularly in sub-Saharan Africa (Kabubo‐Mariara, 2008; Thornton *et al.*, 2007) are negatively affected by extreme high temperatures. An upper critical threshold of about 25 degrees for cattle was found by Hahn (Hahn, 1997), above which cattle showed signs of disrupted behavior and impaired immunity and physiology. Livestock in already hot areas are therefore more *likely* to suffer from warming due to climate change (Renaudeau *et al.*, 2010), although small-scale livestock enterprises are less sensitive than large-scale ones (Kabubo‐Mariara, 2008; Seo and Mendelsohn, 2008).

Damage to *physical assets* due to climate change impacts is especially well documented for poor urban settlements, typically built in risk-prone areas such as floodplains and hillsides susceptible to erosion and landslides. Frequent impacts include destroyed homes by flooding water, mudslides or landslides, disrupted water and sanitation services, and outbreaks of cholera and dysentery. Recent cases show adverse impacts of flooding in large African cities (e.g., Maputo, Accra, Nairobi, Lagos, Kampala), mainly due to inadequate drainage and dense settlements in catchment areas (Douglas *et al.*, 2008) and poor urban agglomerations in many of Latin America's big cities (Burke et al., 2011; Hardoy and Pandiella, 2009). Loss of physical assets in poor areas after disasters is often followed by looting (Hardoy and Pandiella, 2009) and displacement due to loss of property (Douglas *et al.*, 2008).

Erosion of people's *financial assets* during periods of increased climate stress result from loss of farm income and jobs (Alderman, 2010; Alston, 2011; Hassan and Nhemachena, 2008; Iwasaki *et al.*, 2009; Jabeen *et al.*, 2010) and increasing costs of living (Gabrielsson *et al.*, 2012 (forthcoming)). These income losses are compounded by expenses for agricultural inputs (seeds, equipment), school tuition, uniforms, and books, and health expenses throughout the year (Thomas *et al.*, 2007).

Of particular importance, albeit frequently overlooked, is the damage to *human assets* as a result of climate change. This is most evident in increased food security, undernourishment, and chronic hunger due to failed crops (Funk *et al.*, 2008; Misselhorn, 2005; Patz *et al.*, 2005; Renton, 2009); or spikes in food prices most severely felt among poor urban populations (Ahmed *et al.*, 2009; Hertel and Rosch, 2010). Also, various health impacts are recorded, including dehydration, heat stroke, and heat exhaustion resulting from exposure to extreme temperatures (Kakota *et al.*, 2011; Semenza *et al.*, 1999). In India the frequency, persistence, and spatial extent of heat waves have increased significantly (Dash and Kjellstrom, 2011) undermining people's ability to carry out physical work both outdoors and indoors in industries (Ayyappan *et al.*, 2009; Balakrishnan *et al.*, 2010). Other health impacts that curtail human capital are illnesses such as hepatitis, malaria, and dengue, and injuries and drowning (Githeko and Ndegwa, 2001; Hardoy and Pandiella, 2009; Pradhan *et al.*, 2007; Renton, 2009; Zhou *et al.*, 2004). More evidence now suggests psychological effects from climatic changes, ranging from sleeplessness to anxiety and depression (Byg and Salick,

2009; Renton, 2009), loss of belonging and a sense of place (Tschakert *et al.*, 2011), mental disorders (Berry *et al.*, 2010; Kaiser *et al.*, 2001) and suicide (Alston, 2011; Caldwell *et al.*, 2004).

Finally, climate change also impacts *social and cultural assets*. Exposure to a series of climatic and non-climatic stressors and shocks has been shown to be particularly harmful to social networks of the poorest, elderly, and often female-headed households as further erosion prevents adequate mobilization of labor and reciprocal gifts (Osbahr *et al.*, 2008). Climate-related disasters have also disrupted formal social networks, including social assistance programs (Douglas *et al.*, 2008). Changes in seasonality have triggered a sense of loss and bewilderment, particularly with respect to farming identities who feel losing their culturally sustained compass (Renton, 2009).

13.3.1.2. Impacts on Livelihood Dynamics

In addition to impacts on livelihood assets, climatic changes, often in conjunction with other, cross-scalar socio-economic, institutional, or political stressors, affect dynamics in livelihood strategies. These typically range from seasonal to interannual fluctuations as well as entire shifts in livelihoods. These fluctuations often shape the periodic shifting in and out of vulnerability and well-being, or permanent transformations, both desirable and undesirable.

On a seasonal basis, shifting in and out of hardship is not uncommon. To a large extent, these shifts from coping and hardship to recovery are driven by annual and inter-annual climate variability. Figure 13-3 illustrates an annual "wheel of hardship" for the Lake Victoria Basin in East Africa, reflective of coinciding stress from rainfall and temperature patterns, specific farming activities, disease emergence, and household expenses through the course of a year (Gabrielsson *et al.*, 2012 (forthcoming)). Both gradual changes in planting and harvesting seasons as well as extreme weather events can exacerbate these times of hardship. Selling household assets is a common strategy to deal with temporary hardship such as crop failure or disease (Meze-Hausken, 2000; Nelson and Stathers, 2009).

[INSERT FIGURE 13-3 HERE
Figure 13-3: 'Wheel of hardship' – a generalized seasonal calendar illustrating livelihood conditions and stress based on participatory exercises with smallholder farmers from four communities in the Lake Victoria Basin in Kenya and Tanzania (Gabrielsson et al., 2012).]

On an interannual basis, dynamics in livelihood strategies become more pronounced, often as a response to a series of environmental, climatic, and political shocks and stresses. Evidence from rural communities in Botswana reveals that poor hunter gatherers and destitute laborers become more dependent on governmental support and drought relief, having sold most of their productive assets during highly variable rainfall and several drought events, while more diversified agro-pastoralists and commercial business owners displayed fluctuating trajectories, encountering asset losses yet able to diversify their way out of temporary crisis and vulnerability (Sallu *et al*., 2010). More subtle shifts are evident among Kenyan farmers who switch from maize to potatoes, and millet and sorghum, as a response to erratic rainfall and droughts in 2003 and 2009, creating new nutritional gaps (Kamadi, February 9, 2011).

In other cases, people adopt entirely new livelihoods. Thomas et al. (Thomas *et al*., 2007) find that climate-induced increases in precipitation uncertainty resulted in 80% of households interviewed in the Limpopo, North West, and Kwazulu-Natal provinces of South Africa shifting to managing livestock and poultry rather than relying on cropping alone. Migration from climate-sensitive inland farming regions to coastal areas have resulted in shifts from farming to over-specialization in artisanal fisheries (Bunce *et al*., 2010a; Bunce *et al*., 2010b; Coulthard, 2008). Such shifts to marine livelihoods are one example of stressed communities abandoning farming-related incomes (Eakin and Wehbe, 2009). Evidence from pastoral systems in Africa illustrate dynamic struggles (Thébaud and Batterbury, 2001), also suggesting that droughts and conflicts can push herders into migration to cities and destitution (Eriksen and Marin, 2011). Around a drying Lake Faguibine in northern Mali, livelihoods shifted from water-based to agro-sylvopastoral systems, as a direct impact of lower rainfall coupled with more frequent and more severe droughts (Brockhaus and Djoudi, 2008).

13.3.1.3. Impacts on Poverty Dynamics: Transient and Chronic Poverty

There are few studies and little concrete evidence on the extent of poverty dynamics impacted by climate change. Yet, substantial agreement in the literature suggests that shifts from transient to chronic poverty are occurring, even if they are depicted only implicitly. In most cases, these shifts are related to multiple deprivation. For instance, Hardoy and Pandiella (Hardoy and Pandiella, 2009), assessing impacts of climate change on >70 million urban poor in Latin America, note the high odds of many transient poor to become chronic poor after one or a series of disasters; this is particularly true for those who had been displaced and now experience even higher vulnerability than the chronic poor in urban centers. Migrant low-income groups, people in informal settlements, female-headed households, political and environmental refugees, women and children, and native communities are particularly at risk from sliding into chronic poverty, mainly as a result of extreme events combined with an array of other stressors such as widespread poverty, unemployment, lack of urban infrastructure, governmental support, and formal tenure, and inadequate building regulations in areas prone to flooding and landslides (Hardoy and Pandiella, 2009).

Other shifts from transient to chronic poverty are suggested for livelihoods and households that, unlike more affluent ones, lack appropriate response options to climatic changes and, consequently, are squeezed out of alternatives, ending up as chronically poor with constrained solution spaces to reverse this trend. Among fisher communities in Subarnabad, Bangladesh, gradual sea-level rise combined with barrages and other big infrastructure has resulted in salt water intrusion and waterlogging in previous rice and vegetable fields, triggering a significant shift to shrimp farming; however, only the richer and more powerful community members benefit from this shift while the large majority suffers from the loss of livelihood options associated with the disappearance of common resources – food, fuel, fodder, dung, and building material – as well as the erosion of social networks around these resources, slipping deeper into poverty (Pouliotte *et al.*, 2009). Such shifts are also reported by (Demetriades and Esplen, 2008), drawing attention to the elderly poor women and socially and economically oppressed class strata worldwide who, due to irregular access to critical assets and insufficient rights, are unable to cope with unpredictable seasons and extreme events such as floods and droughts and, hence, are increasingly at risk from shifting into chronic poverty.

Those dependent on natural resources as a supplement to climate-sensitive cropping may also slip from transient to chronic poverty, for instance when access to forests is restricted, e.g., through conservation efforts or conflicts, and alternative income-generating resources such as non-timber forest products become unavailable, particularly for women-headed households (Hertel and Rosch, 2010; Shackleton *et al.*, 2007). According to De Merode et al. (De Merode *et al.*, 2004), poor households in the Democratic Republic of Congo obtain 90% of their income from bush meat and fish and 25% from harvesting wild plants. So far, studies on climatic impacts, having emphasized crops, have ignored impacts on forest resources, underestimating socio-economic and political drivers that may make these resources unattainable.

Further shifts from transient to chronic poverty are already occurring as a response to food price increases. Urban poor are particularly at risk since they are almost exclusively net buyers of food (Cranfield *et al.*, 2007; Cudjoe *et al.*, 2010; Ruel *et al.*, 2010). Ahmed et al. (Ahmed *et al.*, 2009), simulating the impacts of a one-time 30-year extreme productivity shocks (extreme wet, extreme dry, extreme hot) on staple grains in 16 developing countries, find that the poor urban laborers are particularly affected, growing by 110% in Malawi, 102% in Zambia, and 95% in Mexico, yet poverty vulnerabilities are highly heterogeneous across different population segments, with sub-Saharan Africa overall as hit hardest. However, differences depend on the character of shocks; under covariate shocks that affect large geographic areas, elastic farm level demand for produce, and small share of expenses directed toward food, some rural house-holds benefit (Hertel and Rosch, 2010). At the country level, Zambia may have lost US$4.3 billion GDP due to the impacts of climate variability of crop yields over a period of 10 years, affecting both rural and urban poor, with a predicted increase in the national poverty rate by 8% under particularly severe drought years (Thurlow *et al.*, 2009)

Even gradual changes in landscapes of everyday life, triggered by shifts in rainfall patterns, can lead to loss of crop yields and income, outmigration to urban centers, and deteriorating social networks at home, making the rural poor even poorer with little hope for improvement (Tschakert *et al.*, 2011). Similar evidence is reported from Australia, highlighting feelings of loss of sense of place, grief, hopelessness, and helplessness among rural albeit not uniformly poor residents and farmers in New South Wales resulting from a ten-year drought (Sartore *et al.*, 2008; Stain *et al.*,

2008; Stain *et al*., 2011), increasing suicide rates among young men in remote rural regions (Alston, 2011). Many of these shifts remain hidden, incompletely captured in poverty statistics. The bulk of attention is oriented toward extreme events and rapid-onset disasters and subsequent impacts on livelihoods and the poor while these creeping, incremental changes occur largely under any official radar, which makes quantification exceedingly difficult.

13.3.1.4. Critical Thresholds, Poverty Traps, and Transformations

Given this new attention to multiple stressors combined with multi-dimensional poverty and deprivation, identifying critical thresholds (tipping points) that denote a shift from transient to chronic poverty or a plunge into poverty traps becomes increasingly important. Such thresholds seem to result from the convergence of various factors, many of which are not directly related to climate change. First, to protect themselves from the negative impacts of gradual changes and rapid-onset events, the poor are increasingly reliant on social networks, including reciprocal gifts and exchanges. However, given limited assets and ability to mobilize labor and food, particularly for smaller and female-headed households, and the elderly, the exhaustion of these reciprocal ties often indicates an imminent slipping into chronic poverty or poverty traps (Hardoy and Pandiella, 2009; Pradhan *et al*., 2007). Second, injuries, disabilities, death, and other impacts on human capital, for instance from destroyed property and accidents following flood events, critically lower poor people's main asset – labor – thus playing particularly important yet overlooked role in poverty dynamics (Douglas *et al*., 2008). Third, the poor tend to sell off their assets, such as livestock, at knock-down prices after climate-induced disasters, shown for the Uganda 2007 floods, then foregoing meals, medicine, and school fees, hence further eroding their human capital (Renton, 2009). Fourth, rising disease levels and psychological distress may plunge poor individuals and households deeper into deprivation; unable to cope, those affected are *likely* to cross a critical threshold into chronic poverty (Renton, 2009), particularly among indigenous groups who risk losing their cultural point of reference due to sea-level rise and other climatic stressors (Green *et al*., 2010), or due to psychological stress and anxiety due to perturbed spirituality (Byg and Salick, 2009).

However, there is also evidence of critical thresholds into new poverty, in areas without previous poverty head counts. For instance, as a result of a ten-year drought in Australia combined with devastating bush fires, white farmers along the main river, the Murray-Darling, suffering declining water availability for irrigation, dying orchards and vineyards, as well as unfavorable water policies, experienced a sharp increase in rural poverty among farming families, farm workers, and contractors, followed by social disruption and depression and large-scale movements of people, dubbed Australia's first 'climate change refugees' (Alston, 2011),:63).

Several of the above may well lead to an increasing number of poor stuck in poverty traps. Among urban dwellers, poverty traps have been reported especially for those in informal settlements that are highly exposed to floods and landslides, who have nowhere else to go and receive no governmental support (Hardoy and Pandiella, 2009) and for urban wage laborers who erode their financial capital to increases in food prices as a consequence of climatic stresses (Ahmed *et al*., 2009; Hertel and Rosch, 2010). In rural areas, poverty traps emerge when poverty impacts of climate change persist over generations, particularly due to lasting stress on ecological systems and environmental degradation, such as in the Sahel (Hertel and Rosch, 2010; Kates, 2000; Sissoko *et al*., 2011; UNCCD, 2011) as well as the inability to rebuild assets after a series of encountered stresses due to marginal activities and unproductive asset portfolios (Eriksen and O'BRIEN, 2007; Sabates‐Wheeler *et al*., 2008; Sallu *et al*., 2010). Poverty traps and destitution are also reported from pastoralist systems, triggered through a combination of drought events, restricted mobility due to conflict and insecurity, adverse terms of trade, and the conversion of grazing areas to agricultural land, including land for biofuel production (Eriksen and Lind, 2009; Eriksen and Marin, 2011).

Other poverty traps result from the erosion of social networks and the inability of the poorest to mobilize food and labor (Hardoy and Pandiella, 2009), heavy debt loads due to the inability to repay loans and distress sales (Renton, 2009), the slow erosion of human assets due to insufficient caloric intake and foregoing the purchase of medicine (Renton, 2009), and persistent discrimination through legal structures and formal institutions, particularly for women and other marginalized groups (Campbell *et al*., 2009). Culturally-induced poverty traps may also play a role in perpetuating poverty under climate change. (Di Falco and Bulte, 2010) argue that forced solidarity among kin in farming communities in Ethiopia discourages effective protection from climate shocks, e.g., through soil fertility management – a culturally-induced poverty trap.

Only scant evidence exists that illustrates successful transformations as a result of climatic and other environmental stress. While the long-term viability of these transformations remains to be seen, the key question revolves around how well they are distributed or accessible throughout the social and cultural strata. Evidence from Botswana suggests that roughly 10% of rural households, engaged in livestock in combination with permanent employment or business ventures, manage to take advantage of shocks through highly specialized activities, hence accumulating assets, spreading risks, and making their livelihoods more resilient (Sallu *et al.*, 2010). In Northeastern Bangladesh, autonomous adaptation of rural communities may result in improved economic and food security situations, hence an example for financial and physical capital accumulation (Anik and Khan, 2011). Transformative change may even emerge where it is least expected: evidence from the Lake Victoria Basin in East Africa reveals that, in the face of ill-health (HIV/AIDS) and climate change, new forms of collective action as a form of social asset accumulation may prove beneficial (Gabrielsson and Ramasar, 2012). Perhaps equally unexpected yet welcome is improved hygiene due to more frequent bathing under higher temperatures in Eastern Tibetan villages (Byg and Salick, 2009).

13.3.1.5. Implications for Inequality

Current evidence suggests that climate change increases inequality, both in urban and in rural areas, in low-, middle- and high income countries. The literature further shows that increasing inequality is not just a side effect of climate change impacts but of the interaction of these impacts with multiple deprivation at the intersection of race, class, gender, ethnicity, age, and disability, also known as intersectionality (Nightingale, 2011). For instance, even in low-income countries, such as Bangladesh, the more affluent and more powerful tend to benefit from climate change, or more precisely the responses undertaken (e.g., shift from rice farming to shrimp farming) while the poor, lacking physical and financial assets and political voice, are conspicuously absent from decision-making processes over land and water use (Pouliotte *et al.*, 2009). In urban areas, such as most major cities in Latin America, upper middle- and high income neighborhoods may also be constructed in flood-prone areas or high-risk slopes yet, unlike poor residents, they can afford insurance and lobby for protective policies (Hardoy and Pandiella, 2009). Increasing harm from negative climate change impacts is also expected in combination with modified social policies and fiscal regimes in northern welfare states, in the aftermath of the financial crisis (Gough, 2012). Such inequalities remain largely unaddressed under dominant disaster discourses, neglecting unequal access to resources and broader policy frameworks that tackle habitat improvement. This section reports primarily on climate impacts on gender, age, and indigenous communities, as they have received most attention in the existing climate and inequality literature.

Abundant evidence points toward increased *gender inequality* as a result of climate change, intertwined with a host of socio-economic, institutional, cultural, and political drivers that perpetuate structural gender inequality (Alston, 2011; Arora-Jonsson, 2011; Brouwer *et al.*, 2007; Buechler, 2009; Carr, 2008; Dankelman, 2010; Demetriades and Esplen, 2008; Galaz *et al.*, 2008; Hardoy and Pandiella, 2009; Lambrou and Paina, 2006; MacGregor, 2010; Nightingale, 2009; Osbahr *et al.*, 2008; Renton, 2009; Resurreccion, 2011; Shackleton *et al.*, 2007; Terry, 2009). While earlier studies have tended to highlight women's quasi-universal vulnerability in the context of climate change (Denton, 2002), this general thrust can mask the complex and intersecting power relations and other fundamental structural causes of inequality (Arora-Jonsson, 2011; Nightingale, 2009; UNFPA, 2009). Moreover, the construction of poor women as vulnerable victims in a one-dimensional narrative perpetuates the negative stereotype of Southern women as helpless, voiceless, and depended on external help; it denies women's agency and places their vulnerability as their intrinsic problem (Arora-Jonsson, 2011; MacGregor, 2010; Manzo, 2010). More recent studies aim to unravel these complexities around a number of axes – gendered livelihood impacts, occupational hazards, social networks around reciprocity, nutrition, emotional and psychological distress, and domestic violence.

_____ START BOX 13-1 HERE _____

Box 13-1. Gendered Impacts of a 10-Year Drought on Australian Farmers in the Murray-Darling Basin (Source: Alston, 2011)

Men and women are differently impacted because of their different roles with agriculture and rural communities. The social impacts are not homogeneous but denote different levels of disruption, from patchy to profound. The

latter, referring to areas with almost total reliance on agriculture, no alternative employment, and limited service infrastructure, are the most socially depressed.

Impacts noted among men: attending to heartbreaking and physically demanding tasks of feeding livestock, carting water, destroying frail animals, and coping with realities of barren and eroding landscape; locked into farms, socially isolated and depressed, crises to their identity and masculinity, increased stress, impacts response capacity, high suicide levels; feel demonized (farmers responsible for crisis), loss of political power.

Impacts noted among women: assisting with farm tasks and working off the farm for additional income; interact more at community level, taking care of others' health, at the expense of their own, also stressed, see no end to their working lives.

_____ END BOX 13-1 HERE _____

Recent work demonstrates that both men and women are impacted by climate change, albeit differentially. Case studies from Vietnam, for instance, demonstrate these differences. Campbell et al. (2009) and Resurreccion (2011) (Campbell *et al*., 2009; Resurreccion, 2011) draw attention to increased workloads for both partners, contingent on socially accepted gender roles, although men tend to work longer hours during extreme events while women take on extra responsibilities during disaster preparation and recovery (storing food and water, taking care of the children, the elderly, and the sick, moving household belongings to elevated areas) as well as when their husbands migrate. In the case of Cambodia, as a reflection of shifting cropping patterns in rice paddies, due to increased temperatures and more irregular rainfalls, Khmer men even accepted culturally-taboo income-generating activities such as cutting trees and trading of charcoal while women worked as wage laborers, raised livestock, and produced rice wine (Resurreccion, 2011).

As for occupational hazards, women tea pickers in Malawi, Kenya, India, and Sri Lanka suffer and die from heat stress as they are paid per hour (Renton, 2009) while emerging evidence points to increasing death cases among male workers on sugar cane plantations, mainly in central America, due to kidney failure (Peraza *et al*., 2012). In case of high male-outmigration as a consequence of unsustainable rural livelihoods, women in Bangladesh face unsafe working conditions, exploitations, and loss of respect (Pouliotte *et al*., 2009). During floods, poor women's mobility is constrained as many have not been allowed to learn how to swim (Demetriades and Esplen, 2008) while such social conditioning forced middle-class women to stay in risk-prone houses during Hurricane Mitch in Nicaragua (Bradshaw, 2010). However, the claim that more women die in disasters is disputed (Arora-Jonsson, 2011). While there is evidence that more women die when they are socio-economically disadvantaged and when disasters exacerbate existing patterns of discrimination (Neumayer and Plümper, 2007; Ray‐Bennett, 2009), combined with lower class and caste during flooding in India shaping location patterns close to swelling rivers, evidence from Hurricane Mitch and other disasters shows a higher mortality rate among men due to culturally-imposed roles as heroes (machismo) (Campbell *et al*., 2009; Resurreccion, 2011; Röhr, 2006).

Several case studies report the 'feminization of responsibilities' (Arora-Jonsson, 2011; Kakota *et al*., 2011; MacGregor, 2010; Nelson and Stathers, 2009; Petrie, 2010; Resurreccion, 2011), adding tasks to the already long list of women's productive and reproductive duties due to climatic changes and extreme events. Internalized gendered roles of agricultural subsistence production can be strengthened, at the detriment of women producers and the well-being of entire households, to maintain existing social orders, including men's authority – a case of a culturally-induced poverty trap during gradually shifting rainfall seasonality, as shown by Carr (Carr, 2008) for Ghana.

In terms of impacts on livelihood assets, women-headed households, in the absence of sufficient financial, physical, and human capital, often rely heavily on social networks of reciprocal gifts and friendship; yet, they are most harmed when these networks are exhausted (Osbahr *et al*., 2008). Negative impacts of climate change such as food shortages make women consume less, but expose them more to water-borne diseases and reproductive tract infections following floods (Campbell *et al*., 2009). Moreover, there seems to be a disproportionate impact on women's mental health due to emotional and psychological distress following climate-related disasters or even gradual environmental and social deterioration, primarily because of their caring roles for others (Alston, 2011; Campbell *et al*., 2009; Demetriades and Esplen, 2008). Evidence shows that marital conflict and domestic violence

have increased as a social consequence of climatic changes and extreme events, translated into increasing stress on livelihoods and the difficulties in securing of well-being, both in high-income countries such as Australia (Alston, 2011) and low-income countries such as Bangladesh (Pouliotte *et al*., 2009) or Vietnam (Campbell *et al*., 2009) and across the globe in general (Demetriades and Esplen, 2008).

Recent evidence is emerging that highlights climate-related impacts on the *elderly, children, and disabled*, so far largely overlooked. An Oxfam study in Vietnam highlights that those least resilient, in addition to single mothers and female-headed households with small children, are disabled family members, widows, the elderly, and men who drink excessively (Campbell *et al*., 2009). Children in urban slums suffer lack of access to water and sanitation as well as poor housing standards, resulting in health impacts at an early age (Bartlett, 2008). Flood-related mortality in Nepal was twice as high for girls as for women (1.33% versus 0.6%) and also higher for boys than for men, and for children in general six times higher than before the flood (Pradhan *et al*., 2007). Less caloric intake due to climate variability and price shocks affect poor children disproportionally, resulting in physical stunting and reduced life-time earnings (Alderman, 2010). A study in Mali showed that the incidence of child food poverty increased from 41 to 52 percent since the food price increases in 2006 with the largest incidence (percentage of poor children) in urban areas but the largest severity (i.e. the gap between poverty line and actual poverty) in rural areas (Bibi *et al.*, 2010).

Urban poor affected by climate change in marginal city areas in Latin America also include *race* (Afro-Latinos) and indigenous communities displaced by guerilla activities (Hardoy and Pandiella, 2009) while urban poverty in urban areas in Africa also carries a female and a child's face, making them doubly vulnerable (Douglas *et al*., 2008). Intersecting indigenous status and class make poor people in the highlands of Bolivia particularly vulnerable (Andersen and Verner, 2009). Only limited evidence exists that relates religious beliefs, such as the angering of gods and lack of spiritual protection in Tibet (Byg and Salick, 2009), to increase in poverty levels, anxiety and psychological stress, rising temperatures, and changes in precipitation patterns.

Poverty also intersects *old age, ethnicity, and social isolation* when it comes to health impacts of climate change (Frumkin *et al*., 2008). In Australia, older citizens have shown feelings of distress and loss as a result of uncertain connection to their lands, combined with social isolation and eroding leisure and retirement activities such as home gardening as well as physical harm related to heat stress and wild fires (Horton *et al*., 2010; Pereira and Pereira, 2008). Elderly citizens in the UK, contrary to their own perceptions, may experience higher exposure and vulnerability to heat waves due to misinformation propagated through bonding networks (Wolf *et al*., 2010). A meta-analysis of 15 European cities shows that 2% of deaths during summer months are attributable to heat, with the largest impact among people 75+ years of age and heat-attributable deaths rising markedly under future warming scenarios (Baccini *et al*., 2008). Heat-related mortality in the U.S. UK, Japan, and New Zealand is also shown to affect primarily the elderly, infants, and persons of lower socio-economic status (Basu and Samet, 2002).

Palpable climate change impacts on livelihoods are seen in the arctic regions. Inuit livelihoods, for example, are based on a climate cold enough for ice and snow to provide them with hunting grounds and means of transportation. Over 70% of the northern Aboriginal adults depend on harvesting natural resources for their living (Furgal and Seguin, 2006) and due to rapid warming their entire lifestyle and culture is threatened (Ford, 2009a; Ford, 2009b; Osofsky, 2006; Salick and Ross, 2009; Tsosie, 2007). Stress disorders, depression, anxiety, feelings of sadness and loss, and other negative health outcomes among Alaska Natives (Bell *et al*., 2010) and Aborigines in Australia (Norton, 2009) are seen as a result of lived and anticipated climatic changes. Also, high latitude livelihoods experience contaminant concentrations in marine mammals and new regulations related to climatic changes affect (McCarthy *et al.*, 2005).

13.3.2. Understanding Future Impacts of Climate Change on Livelihoods and Poverty

Climate change, climate variability, and extreme events already impact livelihoods and poverty across the globe. However, there is a strong likelihood that future climate change, as simulated through a variety of models, will further affect poor people in rural and urban areas, both in the Global North and South, and alter livelihoods and their strategies. Projected impacts will almost certainly make efforts to reduce poverty more difficult. The literature reveals a broad range of anticipated impacts, depending on the mix of climatic, agro-economic, and demographic

models employed, the time frame specified (ranging from 2016-2100), the spatial scale delineated (from a country's agro-ecological zones to global impacts), and the key categories of concern (such as rise in food prices and associated shift in poverty levels, crop yields and food security, health effects, and other impacts).

Existing studies emphasize the complexity and heterogeneity of climate impacts, including winners and losers in close geographic proximity; they also highlight the importance of local and context-sensitive response mechanisms that adequately address these differential impacts, via a 'quilt' rather than a 'blanket' approach (Seo *et al*., 2009). Future impacts of climate change, just as past and current ones, are expected to interact with other stressors, most notably social vulnerability (Iglesias *et al*., 2011), low adaptive capacity and subsistence constraints under extreme poverty (Liu *et al*., 2008), natural resource dependence (Adano *et al*., 2012), population increase (Müller *et al*., 2011), weak institutional support (Menon, 2009; Skoufias *et al*., 2011a; Skoufias *et al*., 2011b; Xu *et al*., 2009) ethnic conflict and political instability (Adano *et al*., 2012; Challinor *et al*., 2007), large-scale land conversions (Assuncao and Cheres, 2008; Assuncao and Cheres, 2008; Thornton *et al*., 2008), and inequitable international trade relations (Challinor *et al*., 2007; Jacoby *et al*., 2011).

Precise estimates on poverty impacts of climate are elusive, though substantial analyses have been performed. The extensive dataset of outlines climate risks and coping ability by countries. The 20 countries most at risk of extreme weather in 2015 will include countries with considerable poverty: MICs (China, India, the Philippines, Sri Lanka, Vietnam, Honduras, Thailand, and Zambia) and LICs (Kenya, Somalia, Djibouti, Mozambique, Bangladesh, Ethiopia, Bolivia, Cuba, Madagascar, Colombia, Zimbabwe). Most of the world's poor live in ten countries, many of who are listed here: China and India (half of the world's poor), Bangladesh, Kenya and the Philippines. Ethiopia and Vietnam also contain a large proportion of the global poor. Not all those poor people in India, China, and other countries will be at risk of climate impacts. Of the top 20 most vulnerable countries to climate change, a total of 11 are MICs, four are LICs and the remaining are members of the OECD.

13.3.2.1. Anticipated Impacts on Economic Growth, Agricultural Productivity, and Living Space

The large majority of future and projected impact studies focus on the anticipated consequences of climatic changes and shocks on agricultural productivity, mainly in Africa, Asia, and South America. Among these studies, most attention is paid to anticipated consequences for economic growth, changes in food prices, consumption patterns and food security, and, subsequently, extrapolated changes in poverty head counts and policy goals to eradicate poverty.

Stern (Stern, 2009), based on United Nations estimates, projects that by 2080, climate change could produce 600 million more people affected by malnutrition and an additional 1.8 billion without enough water. Skoufias et al. (Skoufias *et al*., 2011b), based on predictions for 2055, state that under business as usual and optimal abatement, poverty (measured at $2/day) could be reduced by 800 million people, although lower probability extreme events would reverse this trend and increase poverty. The anticipated reduction in poverty is expected to occur due to annual, global, and real per capita growth rate of 2.2% up to 2055. However, Skoufias et al. (Skoufias *et al*., 2011b) note that mitigation under optimal abatement typically excludes the poor. On a specific country level, Thurlow et al. (Thurlow *et al*., 2009) estimate that Zambia's poverty headcount would increase by 300,000 people under conditions of average climate variability, by 650,000 under a worst ten-year rainfall sequence, and by a maximum of 836,000 people under a one-year extreme drought.

Looking at projected impacts of future climate change on GDP also reveals differential patterns. Mendelsohn et al. (Mendelsohn *et al*., 2006), simulating climate impacts between rich and poor countries by using a mix of climate scenarios and market response functions for 2100, estimate that impact losses in poor nations in low latitudes that already experience high temperatures, mainly in Africa and Southeast Asia, will amount to US$1.2-140.7 billion per year (0.2-23.8% reduction in GDP); richer countries, in contrast, would encounter both positive and negative effects, ranging from US$ 11.7 billion of losses to US$148.7 billion of gains per year (-0.1% to +0.9& GDP), with clearest winners in Russia, Mongolia, Kazakhstan and eastern Europe. Changes in GDP reflect climate-sensitive economic sectors, especially water and energy. An individual country like Zambia would experience US$4.3 billion in foregone GDP during 2006-2016, due to economic losses triggered by climate variability (Thurlow et al., 2009). The

same study concludes that GPD loss for the country could be as high as US$7.1 billion for the same ten-year period, projecting a worst sequence, and as high as US$6.6 billion in just one year under an extreme drought scenario.

A growing body of literature estimates changes in agricultural production and subsequently food prices as a result of future climatic changes and extreme events, often with a specific lens on Africa, Asia, and Latin America (Assuncao and Cheres, 2008; Burke *et al*., 2011; Slater *et al*., 2007; Thomas *et al*., 2007). The scenarios used project mixed results in, typically declines for wheat and both increases and decreases for millet, rice, and maize, for Africa up to 2030 (Challinor *et al*., 2007; Kurukulasuriya *et al*., 2006; Liu *et al*., 2008; Lobell *et al*., 2008) and Latin America up to 2049 (Assuncao and Cheres, 2008; Feng *et al*., 2010; Skoufias *et al*., 2011b). Heat stress will be most detrimental to well-fertilized seeds (Schlenker and Lobell, 2010), which will justify policies in support of traditional seeds. Müller et al. (Müller *et al*., 2011) state that "all African agriculture runs some risk to be negatively affected by climate change", although some parts will benefit. Estimates for Asia and the Middle East also reveal mixed trends (Jacoby *et al*., 2011; Wang *et al*., 2009; Xu *et al*., 2009) and so do studies for Europe (Bindi and Olesen, 2011; Olesen *et al*., 2011). In the North American Corn Belt, declines in corn production are expected to increase 5-year net outmigration by 3.7% for those aged 15-59 from 2020-49 (Feng *et al*., 2010). For 2050, losses in agricultural productivity are projected to be highest in all of Africa, ranging from 10% in East Africa to 20% in Central Africa compared to 2008, and 10-13.5% for Asia and the Middle East (Wheeler, 2011). By 2080, a significant decrease in land productivity is expected for sub-Saharan Africa (-14% to -17%) and Southeast Asia (-18% to -32%), coupled with increase in water demand, while lowest risk profiles are projected for North America, Europe, East Asia, Russia, and Australia (Iglesias *et al*., 2011).

As for future impacts of sea level rise on living space for the worlds' poor, India and Indonesia (MICs) are projected to experience dramatic increases in the size of the population vulnerable to sea level rises –80% and 60%, respectively –, housing a combined total of over 58 million of the most vulnerable people by 2050. A further six million people in China will also be exposed to sea level rises to make the total in that country 22 million. Nigeria, the Philippines and Egypt will also see the size of their vulnerable populations more than double between 2008 and 2050, exposing many of the future 6-14 million to sea level rise. Of the LICs, the size of Bangladesh's vulnerable population is, unsurprisingly set to grow to 27 million people – more than double the 2008 size (Wheeler, 2011).

[INSERT FIGURE 13-4 HERE
Figure 13-4: Map from Wheeler's data set. Direct risks from sea-level rise (without adaptive responses).]

13.3.2.2. Implications for Livelihood Assets and Poverty Dynamics

Although changes in crop yields typically do not indicate direct implications for poverty and livelihoods, changes in food prices and price-induced earnings associated with impacts on agricultural production do (Schmidhuber and Tubiello, 2007). Simulations for over a dozen developing countries (Ahmed *et al*., 2009; Hertel *et al*., 2010) indicate that urban and wage-labor dependent households will be most affected. Changes in price-induced earnings will lower the welfare of low-income households since they will have to use a larger income share to purchase staple crops, particularly rice, wheat, and coarse grains. Yet, impacts will be highly heterogeneous. A one-time 30-year maximum extreme dry event is expected to affect the urban wage population most severely in Bangladesh, Mexico, Zambia, and Malawi, increasing poverty for this socio-economic stratum by 30-110%, while self-employed farming households will face the smallest increase in vulnerability due to asset consolidation (Ahmed *et al*., 2009). Similarly, poverty among the agricultural self-employed, especially in the Chile, Thailand, Indonesia, and the Philippines may drop sharply due to benefits from selling surplus production at higher prices (Hertel *et al*., 2010). Welfare decline in South Africa by 55%, in Malawi by 40%, as well as in China and the United States by 20-25% may result from high sensitivity of crops to rapid temperature increase by 2030, leading to higher food prices (Hertel and Rosch, 2010). The key point is that in most developing countries the poverty headcount will decline in some socio-economic strata while increase in others; only in the large majority of African countries are yield impacts expected to be too severe to allow any benefits (Hertel and Rosch, 2010). Yet, even in the most promising cases, cumulative poverty is expected to increase, despite reductions in the percentage poverty headcount. It should be noted that country-based simulations typically overlook variations within states, e.g., the fact that most poor people already live in areas that tend to be drier and hotter, without access to capital and other resources to purchase food (Mendelsohn *et al*., 2006).

Decline in crop yields is also expected to increase outmigration, especially from developing countries in which rural livelihoods depend on climate-sensitive crops. In the case of Mexico, climate change is projected to result in a decline in crop yields, which, mainly among rural states where agricultural livelihoods are expected to become increasingly difficult to maintain, may induce 1.4-6.7 million of adult Mexicans (2-10% of its current adult population) to emigrate, the large majority to the United States (Feng *et al*., 2010)

In terms of impacts on livelihood assets, projections tend to highlight the erosion of financial capital due to increases in food prices (Ahmed *et al*., 2009; Hertel *et al*., 2010; Jacoby *et al*., 2011; Seo *et al*., 2009; Skoufias *et al*., 2011b; Thurlow *et al*., 2009)), reduction in human assets due to decline in nutritional status (Liu 2008), increasing infectious disease transmission rates (Green *et al*., 2010), loss of labor due to outmigration (Feng et al., 2010), and impacts on natural capital due to lower agricultural productivity (Jones and Thornton, 2009; Skoufias *et al*., 2011b; Thurlow *et al*., 2009). Projections show a substantial increase in future heat-related mortality (Huang *et al*., 2011). Certain risk factors, such as age, cardiovascular and respiratory illness, and socioeconomic status fuel vulnerability to summer heat stress (Basu and Samet, 2002; McGregor *et al*., 2006). Knowlton et al. (Knowlton *et al*., 2007), simulating premature heat-related deaths in the 1990s and 2050s in the northeastern U.S., show an increase in cases by 47-95% by the 2050s, with urban counties depicting higher elevated risk factors than less-urbanized counties. Among residents over the age of 65 in Californian metropolitan areas, future heat-related mortality will increase 10-fold from 2000 to 2099, mainly due to a rising and aging population (Sheridan *et al*., 2012). In comparison, impacts on social and cultural assets have received little attention. Exceptions refer to impacts on the social identity and cultural connections with land and sea among indigenous populations threatened by sea level rise and potential relocation (Green 2010) and conflicts between ethnic and/or religious groups (Adano *et al*., 2012). Poor households with limited social networks or governmental assistance will be worst off, as shown for Nepal (Menon, 2009) and Indonesia (Skoufias *et al*., 2011a).

Climate change is also projected to cause shifts from one livelihood to another. As shown for marginal cropping areas in Africa, based on simulated probabilities of failed seasons projected for 2050, shifts from cropping to higher dependence on livestock are identified (Jones and Thornton, 2009; Thomas *et al*., 2007). In pastoralist systems in Africa, subtle shifts are expected from mixed crop-livestock livelihoods to those based exclusively on pasture livestock, as a result of increasing water scarcity, up to 20% reduction in the length of the growing period for crops, and loss in stovers due to maize substitution (Thornton *et al*., 2007). Yet, the same study highlights new and undesirable challenges for live-stock-depend livelihoods resulting from decreasing livestock biodiversity, land encroachment for biofuel production, expanding vector populations affecting both people and animals, all of which may exceed local adaptive abilities. High summer temperatures in Kenya will be detrimental to the livestock sector (Kabubo-Mariara, 2009).

13.3.2.3. Critical Thresholds, Poverty Traps, and Impacts on Transient and Chronic Poverty

There is a high likelihood that poor countries will experience even greater poverty as a result of climatic changes and extreme events: based on their location and low-latitudes high temperatures (Mendelsohn *et al*., 2006) , their anticipated further decline in adaptive capacity combined with reductions in agricultural productivity (Iglesias et al., 2011), greater inequality and deep-rooted poverty (Jones and Thornton, 2009), and lower levels of education and large numbers of young dependents (Skoufias *et al*., 2011c). A disproportionate impact will continue to fall on developing countries (Nordhaus, 2010; Smith and Vivekananda, 2009), with between 22 and 32 thousand additional child deaths per year, and 12 to 17 million additional people living on less than $2/day among already poor populations in sub-Saharan Africa and South Asia (Anderson, 2006). Households in developing countries dependent on urban wage labor are *highly likely* to find themselves in a poverty trap due to extreme exposure to food price increases (Ahmed *et al*., 2009; Hertel *et al*., 2010). In Zambia alone, this could mean 2/5 of all increases in poverty by 2016 (Thurlow *et al*., 2009).

Lessons from the prolonged Ethiopian drought of 1998-2000 and Hurricane Mitch in Nicaragua in 1998 demonstrate that poorer households tend to engage in asset smoothing, which may dip their consumption to painfully low levels, while wealthier households typically sell assets and smooth consumption (Carter *et al*., 2007; Jacoby *et al*., 2011).

Hence, it is the poor who further erode nutritional levels and human health while desperately holding on to their limited yet precious assets. This trend is expected to become more severe, given the compounded impacts of climate change and multi-dimensional poverty and the difficulty to escape poverty traps, especially without external support.

Projections suggest a climate-induced change threshold for most natural-resource-dependent communities, beyond which catastrophic shocks to livelihoods and poverty are *likely* to occur, unless drastic adaptation and/or mitigation policies are implemented in a timely manner. Smith et al. (Smith and Vivekananda, 2009) (2009: 4137) show "growing evidence that even modest increases in GMT [global mean temperature] above levels circa 1990 could commit the climate system to the risk of very large impacts on multiple-century time scales." Similarly, for the greater Himalayas, such livelihood thresholds are assumed, but empirical evidence is still lacking (Xu *et al.*, 2009). The potential need to relocate due to sea level rise would constitute a critical threshold for indigenous groups such as the Torres Strait Islanders between Australia and Papua New Guinea as it would affect their social identity and cultural connection to specific lands and the sea (Green *et al.*, 2010) . Transitions from cropping to livestock due to climate change are expected in marginal crop areas and high probabilities of failed seasons, coupled with high population densities and persistent poverty (Jones and Thornton, 2009).

Existing projections do not provide sufficient evidence to estimate whether shifts from transient to chronic poverty are expected to occur as a result of climate change, and to what extent. However, a predictable increase among the urban poor, especially urban wage laborers, due to food price-induced earning changes, suggests that a large number of urban poor in developing countries may shift from transient to chronic poverty, especially under scenarios with long-duration climatic shifts and prolonged droughts. For sub-Saharan Africa and South Asia, a shift from poverty to severe poverty is projected for additional tens of thousands of people by 2100 (Anderson, 2006). Also anticipated are shifts in and out of poverty, as projected for small-scale coffee farmers in Mesoamerica by 2050, due to areas no longer suitable for coffee and other, higher-altitude locations to become suitable, as well as differential access to technical and climatic information and cultural constraints with respect to shifting crops (Laderach *et al.*, 2011).

13.3.3. Implications for Development, Sustainability, and Justice

Evidence from observed impacts of climate change on livelihoods and poverty, as well as anticipated future impacts from a variety of projections suggest that development for poorer nations and long-term sustainability of social systems and resilience of livelihoods embedded in functioning ecosystems and their services are already undermined and will continue to be eroded into the future. Using the definition of vulnerability employed in the SREX (Field et. al., 2012), the propensity or predisposition of poor people around the world to be adversely affected by the impacts of climate change is very high. However, these detrimental impacts are only partially attributable to climate change itself. As demonstrated through a variety of case studies, climate-related impacts on marginalized livelihoods and poor populations, both in rural and urban areas, in low-, middle-, and high-income countries, are intimately tied to deep-rooted structural causes of poverty and inequality and a multitude of socio-economic, institutional, political, and cultural stressors (cross-reference to Ch1). As stated by Pouliotte et al.(Pouliotte *et al.*, 2009), as long as the root causes of poverty, entrenched in persistent inequalities and uneven access to resources and institutions, remain an 'elephant in the corridor', all adaption efforts and policies will be nothing more than 'stop-gaps'. At the same time, there is consensus that poverty alleviation in itself, particularly if perceived through an economic lens, will not lead to more equality, neither for disenfranchised women nor men, nor to enhanced livelihood resilience and well-being.

The current literature indicates that livelihood resilience – the ability to withstand disturbances – among poor people is further threatened by negative impacts of climate change, and this for several reasons. First, increasing frequency and severity of hazards undermine livelihood strategies of already struggling individuals and communities (Hardoy and Pandiella, 2009) . Second, while poor countries are hit disproportionally harder by climate-related catastrophes (e.g., storms and floods) and human costs (death) are much higher – the five top ranked in the 2009 Global Climate Risk Index were Honduras, Bangladesh, Nicaragua, the Dominican Republic, and Haiti (followed by five additional developing nations) –, these countries rank much lower in terms of damage costs than countries affected in Europe and North America, given that land, property, and lives in the poorer nations are valued much less, while social support measures are much cheaper (Renton, 2009) . Third, poorer households often cannot afford to take up insurance (Hertel and Rosch, 2010). Fourth, policy priorities typically favor more powerful constituencies (Alston,

2011). Fifth, persistent marginalization due to gender, class, race, and age exacerbate inter-secting inequalities (Demetriades and Esplen, 2008; Galaz *et al.*, 2008)). Sixth, the poor are typically excluded from decision-making processes over vital assets and, hence, have little ability to shape outcomes (Pouliotte *et al.*, 2009). Seventh, emphasis on rapid-onset events, sectoral impacts, and poverty statistics has diverted attention from the more incremental changes that define growing loss and poverty in rurality (Kelly, 2009; Petheram *et al.*, 2010; Tschakert *et al.*, 2011). Finally, desirable livelihood transformations and trajectories towards increased well-being tend to be reserved to more affluent and powerful members of society while poorer households find themselves increasingly squeezed out of 'feasible solution space', especially livelihood diversification (Pouliotte *et al.*, 2009; Skoufias *et al.*, 2011a). These factors perpetuate the vicious cycle of poverty, multi-dimensional deprivation, and inequality.

Looking into the future, poorer countries will experience continued decline in adaptive capacity, which will hamper development. An adaptive capacity index, similar to a Gini coefficient, illustrates increasing inequality with more and more severe climate change scenarios (Iglesias *et al.*, 2011). It reflects natural and economic capacity, social capital, and farming innovation. Just comparing land productivities for 2080, declines will range from 17- 32% in the Near East, sub-Saharan Africa, and Southeast Asia while producing clear winners in Europe and North America (+6-15%) (Iglesias *et al.*, 2011). Besides, there is significant agreement in the literature that currently poor and food-insecure regions will continue to be disproportionately affected into the future (Adano *et al.*, 2012; Anderson, 2006; Assuncao and Cheres, 2008; Burke *et al.*, 2011; Challinor *et al.*, 2007; Jacoby *et al.*, 2011; Jones and Thornton, 2009; Liu *et al.*, 2008; Lobell *et al.*, 2008; Menon, 2009; Nordhaus, 2010; Skoufias *et al.*, 2011a; Thornton *et al.*, 2008) While these studies stress the heterogeneity of future impacts on poverty, few consider more diverse climate change scenarios (Skoufias *et al.*, 2011b) or the potential of four degrees and beyond (New *et al.*, 2011).

Given existing projections ranging from the sub-national to the global level, it is *highly likely* that climate change will slow down the pace of poverty reduction, further erode food security, and jeopardize sustainable development(Hope Sr, 2009; Iglesias *et al.*, 2011; Skoufias *et al.*, 2011b; Stern, 2009; Thurlow *et al.*, 2009) . It should be noted, though, that the top MDG (halving the prevalence of hunger by 2015) is *unlikely* to be realized before 2020-30, with or without climate change (Tubiello *et al.*, 2008). This is particularly the case for newly emerging hotspots of hunger by 2030, including nations such as Tanzania, Mozambique and the Democratic Republic of Congo (Liu *et al.*, 2008).

Little knowledge exists to date regarding how future poverty will intersect with various types of inequality due to gender, ethnicity, or class, and effect social justice. Among the few are global projections until 2080 that highlight gender inequality not only as a key component of socio-economic vulnerability but also as perpetuating inequalities and injustices, which, subsequently, will lower adaptive capacity while increasing poverty and undermining sustainable development (Iglesias *et al.*, 2011). Climate change may also aggravate marginalization of indigenous populations, magnifying their remoteness and insufficient access to health care and infrastructure (Green *et al.*, 2010). However, experiences from Hurricane Katrina and the 2011 Tsunami in Japan demonstrate the additional and multiplier effect of a disaster on top of underlying structural inequalities; their persistence years later, as in the case of Katrina (Schwartz, 2007), further stresses the need for expanded analyses beyond the events themselves.

13.4. Assessment of Impacts of Climate Change Responses on Livelihoods and Poverty

This section assesses the observed and potential impacts that climate change responses have on livelihoods and poverty. Evidence of current impacts of climate change on livelihoods and poverty suggests that the large majority of poor and marginalized people is already disproportionately affected by climatic changes and will continue to be affected in the future, in addition to new and higher numbers of poor in middle-and high income countries. This section assesses whether climate change responses are likely to amplify or reverse this trend. It first reviews the impacts on livelihoods and poverty of the institutionalized mitigation mechanisms under the UNFCCC (CDM and REDD+). Second, it surveys various international and national policy initiatives that are directly or indirectly aimed at mitigating climate change, such as the voluntary carbon market and bio-fuels. Third, it assesses the impacts of various climate change adaptation initiatives on livelihoods and poverty.

13.4.1. Mitigation Responses

Many potential synergies between climate change mitigation policies and poverty reduction have been identified and described in the literature (Klein *et al*., 2005; Ürge-Vorsatz and Tirado Herrero, 2012) but concrete evidence of positive synergies is scarce. Instead there are rising concerns and evidence that policies aimed at mitigating climate change can be detrimental to poor people and their livelihoods (Collier *et al*., 2008; Hertel and Rosch, 2010).

13.4.1.1. The Clean Development Mechanism (CDM) – Focus on Reforestation and Carbon Sequestration

The UNFCCC secretariat showcases a number of CDM project to highlight their development benefits. Projects as diverse as low cost energy services in India, micro-hydro projects in Bhutan and Peru, efficient firewood use in Nigeria, and biogas digesters in China are expected to generate livelihood benefits and employment, and reduce poverty among beneficiaries (cdm.unfccc.int/about/ccb/index.html). However, most of the statistical information reported in the official reports on CDM is based either on project documents or on surveys of projects. The assessment of CDM in the peer-reviewed literature is more cautious and pessimistic than UNFCCC when highlighting obstacles and ethical dilemmas associated with carbon trading (Liverman, 2009), difficulties associated with its implementation (Borges da Cunha *et al*., 2007; Gong, 2010), its procedural limitations (Boyd and Goodman, 2011; Kiss *et al*., 2002), and its failure to achieve poverty alleviation in a meaningful or effective manner (Olsen, 2007; Pfaff *et al*., 2007; Sirohi, 2007).

Studies focusing on the institutional or ethical aspects of CDM as well as studies examining specific projects have expressed concerns about its effectiveness in addressing poverty. For example, Boyd and Goodman (Boyd and Goodman, 2011)p 848) suggest that CDM is likely to accentuate uneven development unless local populations are integrally involved in the implementation of CDM projects. A number of studies discuss low community capacity as a pervasive barrier to the trickling of material benefits from CDM projects to the rural poor (Minang *et al*., 2007; Perez *et al*., 2007).

Recent reviews of benefits of CDM projects that focus on poverty reduction are starkly negative in their assessment. Michaelowa and Michaelowa (Michaelowa and Michaelowa, 2011) : 259) argue, “hardly any of the CDM projects can be considered as strongly pro-poor.” An earlier careful review of more than 200 studies of CDM reaches a conclusion that is almost exactly the same when it suggests, “left to market forces, the CDM does not significantly contribute to sustainable development” (Olsen, 2007).

13.4.1.2. Reduction of Emissions from Deforestation and Forest Degradation (REDD+)

Over the past few years, discussions about REDD+ constitute one area of optimism in relation to climate change mitigation (Agrawal *et al.*, 2011). Extensive donor investments to prepare developing countries to implement REDD+, commitments by six developed countries to provide $4.5B by 2012 for REDD+, and projections that REDD+ investments may reach $30B a year by 2020 suggest that REDD+ has the potential to deliver substantial emissions reductions, in particular because costs of reducing terrestrial emissions may be much lower than those of energy use-related emissions (Stern, 2009). But this potential is likely to be realized only with additional financial flows from donors, or through the involvement of non-government actors in the wake of credible official commitments for emissions reductions.

The use of forests to manage emissions raises important questions about whether carbon forestry will adversely affect the livelihoods of poor people. Some studies show favorable results in terms of poverty alleviation from forest protection (Ferraro *et al.*, 2011), some are optimistic that REDD+ can work (Kanowski *et al.*, 2011; Rahlao *et al.*, 2012) while many have voiced concerns about negative impacts on poor households (Larson, 2011; McDermott *et al.*, 2011; Neupane and Shrestha, 2012; Phelps *et al.*, 2010; Rahlao *et al.*, 2012; Van Dam, 2011). The potential negative impacts include the risk that local populations become excluded from using these forests and that national and global level MRV mechanisms will undermine the role of communities and households in information gathering and documentation of the state of forests.

The Cancun Agreements highlight a number of safeguards that governments should observe during REDD+ implementation, including the interests of local communities and indigenous peoples, the importance of participatory processes, and the need to attend to the sustainability of local livelihoods. The extent to which these safeguards will be observed in practice is unclear because of the early state of REDD+ implementation in most countries. The fact that there is no global REDD+ mechanism means that progress on REDD is likely to occur as much through voluntary bilateral and public-private processes as through multi-lateral, regulatory requirement. Without a global agreement and mandated emissions reductions, the price of carbon is likely to remain low and vary substantially across different carbon forestry projects, thereby strengthening the hands of buyers of carbon credits, and weakening local interests.

The existing experience of REDD+ implementation is inadequate to permit broad generalizations about the effects of REDD+ on rural livelihoods and poverty (Cotula *et al.*, 2009; Hayes and Persha, 2010). Nevertheless, most current writings on REDD+ highlight the weak hand of local communities (Basnet, 2009; Osborne, 2011). In a study of 20 REDD+ projects in Latin America, Africa and Asia, only five had conducted some form of assessment of the outcomes or impacts, and the conclusion was that there was a severe lack of rigor and consistency in the implementation and evaluation of REDD+ projects (Caplow *et al.*, 2011).

Based on past experiences of forestry projects in a number of countries as well as through studies of ongoing REDD+ implementation in countries such as Brazil, Indonesia, Mexico, Tanzania, Nepal and Madagascar, the following six factors are viewed as critical for improving the livelihood contributions of REDD+ projects for the rural poor: 1) recognition of the rights of local communities; 2) participation of local peoples in decision making; 3) involvement of local stakeholders in monitoring and enforcement; 4) creation and provision of alternative livelihood options; 5) transition payments and compensation for reduced emissions; and 6) transparency of decision making and accountability of decision makers (Springate-Baginski *et al.*, 2010).

13.4.1.3. Voluntary Carbon Offsets

The voluntary carbon offset (VCO) market enables companies and organizations that are not regulated as well as countries that have not ratified the Kyoto Protocol to offset their emissions. The VCO market grew exponentially from less than 10 MT CO2 in the early 2000s to 127 MT in 2008, but dropped significantly in 2009 (Hamilton *et al.*, 2010; Lovell, 2010). Activities under the VCO are generally more diverse and flexible than the highly regulated Kyoto Protocol compliant market. The voluntary market is small compared to the regulated market (about 1%) but still significant from a livelihoods and poverty perspective because it typically target smaller projects and may therefore potentially be better at reaching poor communities and people are willing to pay for carbon offsets with co-benefits such as poverty alleviation (MacKerron *et al.*, 2009). Instead of the legal rules and regulations under the Kyoto protocol, most VCO activities are governed by a voluntary certification, some of which require environmental and/or social co-benefits (Kollmuss *et al.*, 2008).

Activities under VCO are dominated by methane destruction in landfills (31%) but forestry projects (20%) and small scale renewable energy projects (15%) are also important (Hamilton *et al.*, 2010). It is too early to tell whether these VCO projects are successful or not in terms of poverty alleviation and other social goals. The results to date are highly mixed with some successes and many more problems (Estrada and Corbera, 2012; Jindal *et al.*, 2008; Jindal *et al.*, 2010; Swallow and Meinzen-Dick, 2009). Reported benefits include increased disposable income and diversification of livelihoods, conservation of existing biodiversity, and strengthening of local organizations while known negative impacts include exacerbated inequalities and loss of access to local resources (Estrada and Corbera, 2012). A comprehensive study of three soil carbon sequestration projects in Kenya, Peru and Senegal, conclude that even if soil carbon projects are beneficial for reducing the loss of soil carbon from agriculture, the impacts on poverty are marginal and that the poorest farmers are unable to participate due to the same factors inhibiting more productive practices in the first place (Antle and Stoorvogel, 2009).

13.4.1.4. Biofuel Production and Large-Scale Land Acquisitions

The global production of ethanol for fuel increased by 327% from 2000 to 2009 and the production of biodiesel increased by 2,725% in the same time period (Chum *et al.*, 2011). Views on this development differ considerably among different interest groups. Reports from corporate interests are mainly positive and assessment from environmental and developmental NGOs are generally negative, while intergovernmental and independent research institutes as well as academia remain ambivalent (White and Dasgupta, 2010). There are mainly two kinds of concern from the perspective of livelihoods and poverty with respect to the increasing global interest in biofuels: food price increase through competition for land, and dispossession of people's land and power.

The increasing demand for biofuels has resulted in a notable shift from the production of food to the production of fuels which in turn may increase food prices (Collier *et al.*, 2008). High food prices are detrimental to poor people who are net buyers of food, i.e. nearly all urban poor people and currently most of the rural poor people (Ruel *et al.*, 2010; Von Braun and Ahmed, 2008). People who are poor spend a very high proportion of their disposable income on food and, hence, are highly vulnerable to high food prices (Ruel *et al.*, 2010). The link between increasing biofuels production and food prices has been the subject of intensive debate since the food price hike in 2007/08 (Ruel *et al.*, 2010). Even if most studies agree that increasing biofuels production plays a role in increasing food prices there is little consensus on the current size of this influence. Estimates of the influence of biofuels on the 2007/08 food price increases have ranged from 70% (Mitchell, 2008) to 30% (Von Braun and Ahmed, 2008). Reports based on top-down economic modeling seem to agree that the biofuels were less influential (< 30%) as a direct cause of food price increases (Ajanovic, 2011; Aksoy and Isik-Dikmelik, 2008; Baffes *et al.*, 2010; Elobeid and Hart, 2008). Nonetheless, the emergence of biofuels as a means to reduce the dependence on fossil fuel has altered the land use dynamics which may influence the food prices in more than one way (Hertel and Rosch, 2010; Rathmann *et al.*, 2010). Several studies relate the increasing food prices in 2007/08 to speculation in agricultural futures markets (Ghosh, 2010; Gilbert and McLeman, 2010; Runge and Senauer, 2007) which may very well be driven by expectations of future profits from biofuels (Trostle *et al.*, 2011). The recent IPCC special report on renewable energy highlighted the uncertainties around biofuels' role in food price increases and expressed a general concern over the risk of deteriorating food security with future deployment of bioenergy (Edenhofer *et al.*, 2011).

The second concern with increasing demand for biofuels is the competition for land that may risk a rush for land as a commodity in low-income countries. Large scale trans-national land acquisitions (LSLA) have soared since 2008. In 2009 IFPRI estimated that about 20 million ha had been subject to LSLA (Von Braun *et al.*, 2009) while the World Bank in 2011 estimated the area to be 45 million ha (Deininger *et al.*, 2011). The most comprehensive inventory of LSLA so far, the Land Matrix Project, has compiled a dataset covering totally over 200 million ha of LSLA (corresponding to almost half the size of EU) of which about 70 million hectares were verified in March 2012 (Anseeuw *et al.*, 2012). Most studies discussing LSLA assume that the rapid increase in LSLA since 2008 is partly and indirectly linked to climate change. The production of bio-fuels is considered the main reason for LSLA but the link to climate change may also be through increasing food prices (Daniel, 2011), concerns about future food insecurity (Robertson and Pinstrup-Andersen, 2010; Rosset, 2011; Sulser *et al.*, 2011) as well as the anticipation that carbon markets, e.g. REDD, may increase prices of land (Anseeuw *et al.*, 2012; Cotula *et al.*, 2009; Zoomers, 2010). According to (Anseeuw *et al.*, 2012), the purpose of LSLA globally is primarily biofuels (40%), food (25%) and forestry (3%) but with substantial regional differences.

Whether LSLA are beneficial or detrimental to poor people is contested although most studies show great concerns that that LSLA may cause dispossession of smallholders, competition with food production and environmental degradation (Borras Jr *et al.*, 2011). Another strong reason for concern is that the expansion of bioenergy in general and biofuels in particular increases the corporate power of international actors over governments and local actors with detrimental effects on local agricultural and food policies (Dauvergne and Neville, 2009; Fortin, 2011; Glenna and Cahoy, 2009; Hollander, 2010; Jarosz, 2011; Mol, 2010) and increasing marginalization of smallholders (Ariza-Montobbio *et al.*, 2010; Neville and Dauvergne, 2012). Gender issues are particularly important to consider since access to land and other resources are highly gendered (Arndt *et al.*, 2011; Molony, 2011). So far, however, there is a lack of in-depth research on gender implications of the biofuels expansion in general and LSLA in particular (Behrman *et al.*, 2012). The concerns also differ to some extent between regions and there seems to be more

apprehension about negative consequences for smallholders in Africa than in Latin America (Borras *et al*., 2011) or Southeast Asia (Borras Jr and Franco, 2011).

Through the lens of mainstream economic modeling there is optimism that biofuels may boost investment and economic growth in low-income countries such as Mozambique (Arndt *et al*., 2009) and India (Gopinathan and Sudhakaran, 2011). However, only scant empirical evidence suggests that the potential benefits are actually realized. Poverty and inequalities have not been reduced in the Brazilian ethanol production and international trade in biofuels may exacerbate the existing disparities through increasing competition (Hall *et al*., 2009; Peskett and Institute, 2007). Biofuel in itself will not transform living conditions in rural areas without being integrated into development policies that generate equitable social and economic benefits for the poor (Hanff *et al*., 2011).

13.4.2. Adaptation Responses

Adaptation is arguably the most important priority for low-income countries, although the importance and urgency of adaption has only slowly been recognized by international climate change policy (Pielke Jr *et al.*, 2007). After adaption has been widely accepted in the international negotiations (e.g. the Copenhagen Accord) the financial means to facilitate adaptation are gradually building up. Even if the funds available for adaption have been estimated to cover less than 10% of all needs (Smith *et al.*, 2011), there are significant adaptation activities with implications for poor communities. Such activities are assessed below as well as local responses.

13.4.2.1. Insurance Schemes

Insurance, including both public and private systems, has been proposed by the UNFCCC and others as an adaptation strategy, serving to reduce, share, and spread climate change induced risk and smooth consumption, especially among poor households (Akter *et al.*, 2011; Hertel and Rosch, 2010; Mechler *et al.*, 2006). Poor people tend to be uninsured, at least in the formal sense, though social networks and informal strategies (risk spreading, drawing on social networks, local credit, asset markets, transfers from local households, dividing herds between kin etc) do act as informal risk management mechanisms (Barnett *et al.*, 2008; Hertel and Rosch, 2010). In the case of flooding in South Western Nigeria in 2008 which affected 65 % of fish farms, for example, the majority of the farms were uninsured, and the few that were insured received untimely and inadequate compensation, and very few obtained any compensation from the government. This both affected people's income and productivity and lead to poor health and starvation (Adebo and Ayelari, 2011).

Access to formal insurance schemes can potentially provide a way out of poverty traps (Barnett *et al.*, 2008). It often takes several years for a household to rebuild assets after a climate shock such as drought, meaning that an increase in frequency of such events can trap people into poverty (Dercon, 2006; Hertel and Rosch, 2010). Also, poor people who have no insurance are often forced to invest only in low-risk, low-return production, which prevents them from accumulating enough assets to escape chronic poverty (Barnett *et al.*, 2008; Elbers *et al.*, 2007). Insurance markets may also provide an opportunity for risk-averse farmers to evade culturally-induced poverty traps that bound them to kinship obligation through the moral imperative of sharing which also reduces their incentive for self-motivation against climate shocks (Barnett *et al.*, 2008; Di Falco and Bulte, 2011).

In high-income countries, insurance plays a role for poor people and their livelihoods (Dawson *et al.*, 2011). In a study of a 2008 flooding event in a community in Queensland, Australia, it was found that only 32% of residents and 43% of businesses were insured, in part due to the high cost of insurance on flood plains. Instead, social and institutional networks initiated emergency responses to reduce flood damage; however, relying exclusively on such responses may not be viable in the long run since the burden on these mechanisms will increase with climate change (Keogh *et al*., 2011). Few studies exist of whether uninsured groups in high-income countries can be pushed into poverty or experience a shift from transient to chronic poverty, as a result of climatic events. Under some socio-economic scenarios (such as for the UK), climate change may raise premiums, for example in flood-prone areas, meaning some people are unable to afford insurance (Dawson *et al.*, 2011).

Particular types of insurance have been proposed to reduce poverty, in particular micro-insurance which is directed at low-income people (Biener and Eling, 2012). The costs of micro-insurance are typically low because local providers perform all operational and field-level administration, compared to conventional insurance where the company provides all the services (Akter *et al.*, 2011). Although the microinsurance industry has grown over the past few years (10% per year), only 5% of the potential market is covered (Biener and Eling, 2012). Some of the barriers regarding micro-insurance include the randomness of loss occurrence, information asymmetry, and the uneven affordability of insurance premiums. Index-based insurance has been suggested to address these obstacles, for example through lower transaction costs and simpler contract designs. Weather or crop index insurance is paid out when conditions reach a particular predetermined threshold where significant losses are likely to occur – particular weather conditions such as excessively high or low cumulative rainfall or temperature peaks affecting average crop yields or revenues (Barnett *et al.*, 2008). Systems of insuring animals have also existed for decades in Mongolia (Mahul *et al.*, 2009) and have been tested in Kenya (Matsaert *et al.*, 2011). Livestock are insured against bad weather such as droughts and storms. Specific formats include weather-based insurance and mortality index insurance. Both can promote proactive responses: if payout is made immediately, people can afford to respond by buying supplementary feed, moving to better pastures, and fattening animals. Index-based (livestock mortality) insurance is paid any time the mortality rate of adult animals exceeds a certain historical threshold and, hence, is more reactive. Index-based risk transfer products are meant to transfer risks outside a low-income rural community. This format is particularly relevant for climatic events that strike whole villages or areas, thwarting the capacity of community-based risk management options such as social networks

However, livestock insurance is not without problems. Accurate weather and livestock data required for weather- and mortality-based systems are seldom available in low-income countries. It can be difficult to establish which particular weather condition causes losses, while weather conditions also vary greatly between adjacent areas. Consequently, basing repayment policies on meteorological stations in a different area, even if relatively close in distance, is problematic. Late payouts can also hamper recovery of premium holders. With shifting pasture lands under climate change, background data for calculating relevant indices may become obsolete.

Insurance has been described as a low-regrets climate change adaptation option, for instance in Ethiopia where mechanisms for drought risk financing, including crop insurance, are part of new social protection programmes (Conway and Schipper, 2011). Insurance may be particularly appropriate in areas in which the direction of future rainfall (increase or decrease) is uncertain. However, the viability of insurance systems in the context of climate change is not undisputed. For instance, (Phelan *et al.*, 2011) using a broad conceptualization of insurance including both social insurance (state-provided universal health care) and commercial forms of insurance, argue that the feasibility of insurance systems is dependent on dramatic reductions in emissions as climate change threatens the capacity of insurance systems to pool and spread financial risk on the basis of known probabilities.

To many poor communities, private insurance systems are often unattractive, with claims frequently exceeding premiums, as witnessed in agricultural/crop insurance programmes in India and Bangladesh (McCord and Churchill, 2005; Raju and Chand, 2009) and costly reinsurance for disasters (Akter *et al.*, 2011). Evidence from flood insurance schemes in Bangladesh suggests that illiteracy and poverty lower the demand for insurance due to limited understanding of its potential benefits and sheer lack of financial assets (Akter *et al.*, 2011). Few farmers or herders in low-income countries insure their productive resources – a tendency particularly pronounced among the poor either because of absent or poorly developed insurance markets or amount and timing of premium payments (Giné *et al.*, 2008; Hertel and Rosch, 2010; Pierro and Desai, 2008). There are institutional problems, too: the collaboration between insurers and micro-credit providers is often hampered by incongruous motivations and unequal power relations between the different actors in the insurance market (Akter *et al.*, 2011). Options that are financially more viable and socially equitable entail public provision, collaboration between private actors, civil society, and governments in the provision of insurance, making it compulsory for all, and favoring macro rather than micro insurance products (Akter *et al.*, 2011; Giné *et al.*, 2008; Pierro and Desai, 2008).

Insurance mechanisms may not help poor people to adapt unless the underlying forces that make certain poor people vulnerable, such as economic marginalization, are addressed. Only when insurance is promoted within the context of a broader set of measures to strengthen and diversify livelihoods can it overcome maladaptation, for example through encouraging more risky behavior such as switching to less drought-resistant crops (Hertel and Rosch, 2010).

Otherwise, people may find themselves locked in livelihoods suffering increasing risks under climate change or overexploiting a variable natural resource, such as restocking fishing fleets after a hurricane with new and efficient vessels, at the backdrop of declining fish stocks (Jerneck and Olsson, 2008; Pauly, 2005).

13.4.2.2. Humanitarian Aid as Part of Climate Change Adaptation

The IPCC special report on extreme events (Cooney, 2012) documents the implications of disasters for poor people, their livelihoods, and poverty dynamics, though the concrete effects on human lives, ecosystem services, the informal economy, and other key aspects of poor people's vulnerability remain poorly explored. Evidence from Honduras and Ethiopia suggests that poor people's coping strategies can undermine their well-being both in the short and long term, trapping people in poverty (Carter *et al.*, 2007). To counteract this tendency, disaster risk management is increasingly proposed and tested as an adaptation measure, for example through community-based climate risk reduction ((Meenawat and Sovacool, 2011a; Meenawat and Sovacool, 2011b; Sovacool *et al.*, 2012)). One example of community based adaptation in disaster risk reduction is the innovative 'Triple F' model of Forestry, Fisheries and Food and community-based micro hydro plants (Sovacool, 2012).

Disaster risk reduction includes both short-term humanitarian aid and disaster management approaches as well as longer-term measures to reduce exposure and vulnerability to disasters resulting from climate change (Cooney, 2012). Shorter (practical) and longer term (structural) measures can be synergistic (Cooney, 2012; Tompkins *et al.*, 2008). The IPCC SREX emphasizes low-regrets measures, such as poverty reduction schemes as part of risk management and adaptation in flood-prone informal settlements that offer benefits now and lay the foundation for addressing projected changes (Cooney, 2012). Such examples are documented for Honduras, Brazil, and the Cayman Islands (McSweeney and Coomes, 2011; Tompkins *et al.*, 2008). The integration of such approaches into development planning can provide a window of opportunity to address the structural inequalities that shape socio-environmental vulnerability and multi-dimensional poverty (Tompkins *et al.*, 2008). Risk reduction may be more successful in facilitating deep structural transformation than past development initiatives and anti-poverty interventions, though complementing efforts aimed at enhancing people's adaptive capacity and their livelihood resilience with macro-level, long-term policy responses is essential (Gippner *et al.*, 2012; Mertz *et al.*, 2009; Nuorteva *et al.*, 2010; Rawlani and Sovacool, 2011; Sovacool *et al.*, 2012; Sovacool, 2012; Tompkins *et al.*, 2008).

However, integrating short-term and longer-term measures is not unproblematic. Some short-term measures can increase longer-term exposure and vulnerability; in addition, short-term impacts of hazards may differ from long-term impacts and, consequently, require alternative actions (Conway and Schipper, 2011). For example, in Ethiopia, key institutions dealing with disaster prioritize the targeting of transient food insecurity under short-term climate variability; in contrast, a long-term perspective implies emphasizing vulnerability reduction and livelihood security. In the Sahel, improved capacity to manage droughts, prevent famine, and safe lives has been partly successful in reducing emergencies over the past 35 years (United States. Congress. Office of Technology Assessment, 1986). Nevertheless, results in terms of poverty reduction and transformation of vulnerable livelihood systems have been highly mixed (Batterbury and Warren, 2001; Kates, 2000; Olsson *et al.*, 2005; Reij *et al.*, 2009). Measures that increase poverty and inequity and undermine livelihoods and adaptive capacity could be considered maladaptive, as defined by Barnett and O'Neill (Barnett and O'Neill, 2010).

13.4.2.3. Household and Community Responses

Responses to climate risks and threats, particularly when it comes to coping with risks, have often been classified as reactive vs. proactive (Burton *et al.*, 2006; Smithers and Smit, 1997), spontaneous vs. planned (Smit *et al.*, 1999), or individual vs. collective. Although fuzzy, the distinctions are useful for disentangling different kinds of adaptation responses and their impacts on poverty and inequality (Füssel, 2007).

Agrawal and Perrin identify five types of autonomous responses reflecting links to different categories of risks (Agrawal and Perrin, 2009). The first four are: a) mobility, which helps address risks across space (McLeman and Smit, 2006; Tacoli, 2009); b) storage, which helps smooth temporal fluctuations in resource availability, thereby

reducing risk over time (Howden *et al*., 2007; Smit and Skinner, 2002); c) diversification, which reduces risks to benefit flows from various household assets (Mertz *et al*., 2009; Smith *et al*., 2000), and d) communal pooling which permits households to pool risks across the entire portfolio of income-generating assets and skills (Linnerooth-Bayer and Mechler, 2006). When households lack access to markets, the above classes of adaptation practices constitute a full set of analytically distinct, yet collectively exhaustive forms of adaptation. In case markets are accessible, climate risks can also be reduced through exchange, making market exchange the fifth type of risk reduction and adaptation practices (Halstead and O'shea, 2004).

Early research presented some evidence about the direction of the impacts of these different adaptation strategies on poverty distribution and dynamics (Kates, 2000). Several scholars highlight the fact that such strategies can have positive effects on poverty reduction when they are supported by policy measures, and if institutional links are available to enable access to resources during scarcity (Adger *et al*., 2003; Stringer *et al*., 2009; Urwin and Jordan, 2008). For example, migration in response to predictable climate variability is a well-developed coping mechanism that can allow migrants to maintain assets, and protect livelihoods (Barnett and Webber, 2010). However, when migration occurs because of unexpected, unpredictable, and sudden shocks, it is highly disruptive to livelihoods, even if it constitutes the only available option (Gilbert and McLeman, 2010).

In contrast to migration which is often a last resort option and typically a reactive strategy, both diversification and storage are more proactive adaptation strategies (Smithers and Blay-Palmer, 2001). They are also typically used by those with some resources or surplus at hand. Diversification of income sources, productive asset holdings, consumption, and investments can effectively address uncorrelated risks (Osbahr *et al*., 2008; Seo, 2010), albeit often in exchange for some loss of income (Alpizar *et al*., 2011). As a consequence, poorer households simply lack the cushion in their earnings or sufficient assets to diversify. Pooling, savings, and credit societies as risk-reduction strategies are widespread in most poor societies and play an important role in helping members tide over difficult times (Andersson, E., Gabrielsson, S., 2012). To the extent they are developed and managed by communities themselves, they are likely to be low cost, well targeted, and efficiently administered, even though not necessarily fair. Despite these advantages of supporting livelihoods, caution is needed to identify and rectify gaps in coverage, vulnerability to widespread risks, and potential elite capture (Bhattamishra and Barrett, 2010).

13.5. Evidence of the Interaction between Poverty Alleviation Measures, Climate Change, and Climate Change Responses

This section provides an overview of interactions between climate change, climate change responses and poverty alleviation measures. Because climate change interacts in a myriad way with livelihoods and poverty it is important to assess how this interaction relates to ongoing and future policies for poverty alleviation in order to capture synergies and avoid conflicts. The section covers three broad areas of poverty alleviation, the Millennium Development Goals (MDG), social protection programs and energy access programs.

13.5.1. Millennium Development Goals

In 2000, 189 nations pledged to free people from extreme poverty and multiple deprivations through a human development-centred approach. This became the eight MDGs, to be achieved by 2015. Countries renewed their commitment to these goals in 2010. The IPCC Fourth Assessment Report (Yohe, G.W., Lasco, R.D., Ahmad, Q.K., Arnell, N.W., Cohen, S.J., Hope, C., Janetos, A.C., and Perez, R.T., 2007), highlighted that – with *very high confidence* –climate change will impede nations' ability to achieve sustainable development pathways as measured, for example by long-term progress towards the MDGs. While climate change may undermine efforts to reach the MDGs, the failure to reach these goals in due time has significant non-climatic causes (e.g. (Hellmuth and International Research Institute for Climate and Society, 2007; UNDP (United Nations Development Programme), 2007)). However, empirical assessments of the impact of climate change on MDG attainment are limited (Fankhauser and Schmidt-Traub, 2011) and estimates of the costs of achieving the MDGs (Bourguignon *et al.*, 2008) do not include the additional requirement for adaptation or provisions for a more hostile climate. Similarly,

sectoral analyses of the cost of achieving individual MDGs, commonly do not include the additional cost of adapting to the impacts of climate change (Jones *et al.*, 2003).

Despite a growing body of literature and experience, there remains *limited evidence* to suggest that either observed or projected climate change impacts are being systematically integrated into poverty reduction programming or that such programming results in substantial increases in resilience to covariate and idiosyncratic shocks and stresses (Bene *et al.*, 2012). However, some notable cases exist, such as the Productive Safety Net Programme in Ethiopia, which has sought to consider the impact of climate change and disasters on outcomes, including on high school graduation levels (Gilligan *et al.*, 2009).

13.5.2. Social Protection Programs

Social protection describes all public and private initiatives that provide income or asset transfers to the poor, protect the vulnerable against livelihood risks, and enhance the social status and rights of the marginalized (Devereux and Sabates-Wheeler, 2004). These initiatives have the overall objectives of extending the benefits of economic growth, and reducing the economic and social vulnerability of poor, vulnerable and marginalized groups. They are primarily considered to provide 'protection' for poverty reduction measures and other social programs, not poverty reduction measures in themselves. Social protection can be divided into *core* interventions, such as asset transfers, income transfers and public works, and *complementary* interventions, such as micro-credit services, social development, skills training and market enterprise programs. Social protection has risen significantly up the international policy agenda in recent years, partly due to the impacts of the global financial crises in the late 1990 and early and late 2000s on poor and marginalized people (Davies and McGregor, 2009)

It is increasingly recognized that social protection can play an important role in supporting pro-poor climate change adaptation and disaster risk reduction for vulnerable populations in developing countries by strengthening their resilience to shocks (Heltberg *et al.*, 2010; Stern, 2007). However, little research exists on social protection and policies for poor people in middle- to high-income countries. There is growing consensus among practitioners and researchers that social protection can be an important approach to helping the chronically poor reduce risk and minimize their need to erode valuable and scarce assets when faced with shocks (Barrientos, 2011; Dercon, 2011; Devereux, S., Davies, M., McCord, A., Slater, R., Freeland, N., Ellis, F., White, P., 2010). Table 13-2 provides a summary of the social protection measures and instruments, and associated adaptation and disaster risk reduction benefits (Davies *et al.*, 2009)

[INSERT TABLE 13-2 HERE
Table 13-2: Types of social protection. Adapted after Arnall *et al*. (2010) and Davies and McGregor (2009).]

As Table 13-2 indicates, social protection offers a wide range of benefits for adaptation and DRR, both in response to short-term climate disasters, as well as long-term risks posed by climate change, though much of the literature remains at a normative level. The concepts of Adaptive Social Protection (ASP) (Davies *et al.*, 2007; Davies and McGregor, 2009) and Climate Responsive Social Protection (CRSP) (Kuriakose *et al.*, 2012) both provide a framework for the integration of climate change adaptation and disaster risk reduction that goes beyond traditional social protection such as food-for-work programs. In spite of these conceptual advancements, there are only a few detailed studies on the effectiveness of social protection implementation for responding to and preparing for climate events and climatic changes. Of the studies that do exist, most have been conducted in South Asia (Arnall *et al.*, 2010; Heltberg *et al.*, 2009), although a number have also been completed in relation to individual safety net programmes in sub-Saharan Africa (Devereux *et al.*, 2006; Slater *et al.*, 2006).

Social protection approaches are increasingly used in post-disaster situations to avoid long-term increases in poverty as a result of lost assets. In the post-disaster environment, preliminary lessons from Ethiopia's nation-wide Productive Safety Net Programme (PSNP), which assists the most chronically impoverished with cash transfers and cash-for-work schemes, reveal a positive effect on household food consumption (Devereux *et al.*, 2006) and a reduction in 'distress selling' of assets as well as the protection of household assets (Slater *et al.*, 2006). Other social protection instruments used occasionally in the global south are conditional cash transfers, near-cash instruments

such as vouchers and fee waivers, social funds, and specific services such as child protection, orphanages, and rehabilitation for persons with disabilities (Heltberg *et al.*, 2009). In Bangladesh, recent experiences of asset restocking following disasters (Devereux and Coll–Black, 2007; Marks, 2007; Tanner *et al.*, 2007) demonstrate that such approaches can contribute to reducing vulnerability to climate shocks by providing liquidity and alternative sources of income during times of household stress (Davies *et al.*, 2009). In addition, starter packs and seed fairs have revealed success in boosting food production at the national and household level (Devereux and Coll–Black, 2007). These have been more commonly used in Africa, although concern has been expressed that inputs sourced through commercial seed and fertilizer companies are sometimes inappropriate to local cropping patterns and agro-ecological conditions (Davies *et al.*, 2009).

13.5.3. Energy Access and Poverty Reduction

There is a strong correlation between energy consumption, which accounts for the majority of global greenhouse gas emissions, and per capita income (Edenhofer *et al.*, 2011; Modi *et al.*, 2005). Lack of access to adequate energy limits economic and human development (AGECC (Advisory Group on Energy and Climate Change), 2010) and access to modern energy services is a recognized prerequisite for achieving the MDGs (AGECC (Advisory Group on Energy and Climate Change), 2010; GNESD (Global Network on Energy for Sustainable Development), 2007; Modi *et al.*, 2005). Globally, 1.4 billion people do not have access to electricity and thus have no light in the evening, poor access to modern communication technologies, inadequate education and health facilities, and limited power for economic activities (IEA (International Energy Agency), 2011). The 3 billion people dependent on traditional solid fuels for cooking energy (IEA (International Energy Agency), 2011), suffer the ill-effects of indoor air pollution, which leads to 2 million premature deaths each year (Jerneck and Olsson, 2011), and spend a significant amount of time collecting fuel (Jerneck, A.,Olsson, L., 2012). Under business as usual scenarios, these numbers will have changed little by 2030 (AGECC (Advisory Group on Energy and Climate Change), 2010; IEA (International Energy Agency), 2011).

Access to affordable and reliable modern energy services can reduce household expenditure on energy, reduce the opportunity cost of time spent collecting fuel, improve productivity and increase livelihood strategy options by widening opportunities for productive activity (Practical Action, 2010). However, there is limited evidence that access to modern energy directly or indirectly reduces income poverty. Access to modern fuels for cooking improves health status, especially for women and children (Jerneck, A.,Olsson, L., 2012; WHO (World Health Organization) and UNDP (United Nations Development Programme), 2009), while access to electricity improves people's sense of security and provides opportunities for lifestyle changes.

Renewable energy technologies can be used to increase access to modern energy services in developing countries and minimize GHG emissions from the increased energy consumption associated with poverty reduction (Edenhofer *et al.*, 2011). Their potential varies according to local geography and context (IEA (International Energy Agency), 2011). Apart from low GHG emissions, benefits from the use of renewable energy can be in cost-savings relative to the use fossil fuels, in reduced dependency on imported fuels and in employment creation in the provision of renewable energy services (Edenhofer *et al.*, 2011). Renewable electricity can be competitive under existing market conditions, particularly for rural mini-grid and off grid schemes (IEA (International Energy Agency), 2011). The competitiveness of renewable energy is improving as the cost of some renewable energy technologies falls (e.g. solar PV and wind) (IEA (International Energy Agency), 2011) and the real cost of oil increases (Edenhofer *et al.*, 2011; IEA (International Energy Agency), 2011). However, renewable energy consumption by low-income households will have a marginal impact on fuel imports. Currently, there is limited evidence to suggest that renewable energy technologies have the potential to create more employment than conventional energy systems (Akella *et al.*, 2009; Karakezi *et al.*, 2004).

13.6. Synthesis and Research Gaps

A growing body of literature addresses the linkages between poverty and climate change. However, there still exist important gaps that make assessing the multi-scalar impacts of climate change on livelihoods and poverty a truly

daunting task. The most prevalent measurements of poverty focus on income or a combination of the MDGs, often disregarding other dimensions of poverty and its inherent dynamics. Too little is known about the intensity of poverty below the standard of the International Poverty Line, the distribution of poverty at lower levels of analysis such as within households, poverty dynamics over time, and critical thresholds to long-lasting poverty traps that will inhibit beneficial livelihood transformations under climate change. An appreciation of the multi-dimensional nature of poverty is fundamental for understanding the complex poverty-livelihood-climate change nexus.

An assessment of current impacts of climate change on livelihoods and poverty has revealed the following key gaps. First, there remains a lack of rigorous data collection and analysis, particularly with respect to 'small' disasters in poor people's lives that often go unnoticed (Ahmed *et al.*, 2009; Hardoy and Pandiella, 2009), leading to significant underestimation of embodied experiences with climate change through the fabric of everyday life where loss and harm remain largely undetected (Tschakert *et al.*, 2011). Hence, there is a need for more climatological research informed by the needs of vulnerable livelihoods, for instance on the effects of changing winds as a combined result of climate change and land cover change and their effects on increasing evaporation with implications for water availability as well as changing diurnal temperature ranges important for various vector borne diseases, wellbeing and heat stress on people, plants and livestock. Second, too few efforts have been made to understand the power imbalances and the discriminatory institutional mechanisms that perpetuate inequality, particularly those linked to gender, race, and ethnicity, and make certain groups of people particularly harmed by climate change (Alston, 2011; Arora-Jonsson, 2011; Demetriades and Esplen, 2008). Third, very scant evidence exists on the impacts of climatic changes on children (Bartlett, 2008; Pradhan *et al.*, 2007) and people with disabilities, both physical and mental. Fourth, more research is needed to systematically assess shifts from transient to chronic poverty as a response to climatic and non-climatic stressors. Many of these shifts remain hidden, incompletely captured in poverty statistics and dominant disaster discourses. Fifth, there is a growing need to identify poverty traps and critical thresholds triggered by climatic changes that push transient poor into a chronic state of poverty. Sixth, very limited research exists to date that investigates the impacts of climate change and extreme events on poor people and livelihoods in middle- to high-income countries, despite mounting examples of observed impacts, including the European heat wave, Hurricane Katrina in the U.S., and the ten-year drought in Australia, as well as increasing evidence of rising poverty and inequality in the global North (Gower et. al., 2012; New *et al.*, 2011). The large majority of current research on the nexus between poverty and climate change is conducted in developing countries, mainly in the poorest regions. Seventh, the complex linkages of climate change responses, livelihood trajectories, and poverty dynamics deserves more concentrated attention. Finally, only scarce evidence exists that illustrates successful livelihood transformations as a result of climatic and other environmental stresses.

Equally important are the gaps identified with respect to future climate impacts on livelihoods and poverty. First, it is exceedingly difficult to foresee poverty levels for 2030 and beyond (Hertel *et al.*, 2010). Key assumptions in economic analyses, such as constant within-country distribution of per-capita income over time and non-adjusted agricultural prices, technology, and inputs, are restrictive when projecting poverty in the distant future (Seo *et al.*, 2009; Skoufias *et al.*, 2011b). Second, no prediction exists as to individual poverty trajectories, although higher individual burden than aggregate national projections would be expected (Mendelsohn *et al.*, 2006). Third, not enough consideration is given to extreme shock events that exceed historical evidence (Ahmed *et al.*, 2009) and more diverse, low-probability-high impact scenarios (Burke et al., 2011; New *et al.*, 2011; Nicholls *et al.*, 2011), resulting in an underestimation of impacts on the lives and livelihoods of poor and marginalized people. Fourth, projections across space and time make detection and attribution difficult as model parameters tend to vary significantly. Fifth, the large majority of projections leave out adaptive and mitigative measures, including climate change risk management tools, to reduce negative impacts on the poor (e.g., (Assuncao and Cheres, 2008; Iglesias *et al.*, 2011; Jacoby *et al.*, 2011; Jones and Thornton, 2009; Liu *et al.*, 2008; Xu *et al.*, 2009)). Sixth, climate change impacts are often projected onto estimates for agricultural production and economic growth, portraying a linear relationship with poverty headcounts while omitting potentially more vital facets of multi-dimensional poverty. Seventh, there is a lack of systematic research on the direct and indirect effects climate change instruments such as the CDM and REDD on livelihoods and poverty, and how such research can inform policy formulation and implementation processes. Finally, policy responses, especially when involving capital intensive and high-tech agriculture for increasing agricultural production, need to be scrutinized for their impacts on the poor.

Frequently Asked Questions

FAQ 13.1: How important are climate change-driven impacts on poverty and livelihoods in comparison to other drivers and causes of poverty?

Poverty is a multi-faceted phenomenon, and climate change interacts with poverty in many different ways. There is clear evidence that direct impacts of climate extremes, such as floods, droughts, heat-waves, and hurricanes, are having profound effects on people who are poor and, consequently, less protected in terms of housing and infrastructure and less able to participate in decision-making on adaptation. People who are poor and are net buyers of food, particularly the urban poor, have been severely affected by increasing food prices. This is a major reason for the large number and even increasing number of food-insecure people across the world. Climate- related drivers often co-exist and amplify other drivers of poverty, such as lack of access to markets, credits, health services, unequal power structures, and political influence. Unfavorable natural conditions in terms of soils, climate, and geographical location also play important roles in combination with climate change impacts.

FAQ 13.2: What livelihoods are particularly vulnerable to climate change impacts?

Livelihoods that are closely intertwined with climate-sensitive natural resources, such as rain-fed agriculture, pastoralism, and fishing are particularly vulnerable to impacts of climate change. Livelihoods in climate-sensitive locations, such as low lying coastal areas, flood plains, dry-lands, and mountainous regions are also highly vulnerable. In urban areas, poor people are often forced to inhabit hazardous areas such as areas prone to floods and landslides. Urban slums are acutely vulnerable to combinations of heat-waves and high levels of air-pollution. Moreover, children- and female-headed households and other marginalized populations often suffer multiple deprivations and inequalities that make them exceedingly vulnerable to climatic and other stressors rather than their particular livelihood *per se*.

FAQ 13.3: Are there unintended and negative consequences of climate change policies for people who are poor?

Several climate change policies may be detrimental to people who are poor. For example, the production of biofuels such as ethanol and bio-diesel to replace petrol and diesel compete for agricultural land with food production. It is clear that many poor people across the world are suffering from exceptionally high food prices since 2008. There is most likely a link between biofuels and soaring food prices but the strength of it is unclear. The recent rapid increase in large scale land acquisitions, often detrimental to poor people, may also be to some extent linked to food and energy policies in the developed world. The construction of dams for hydro-electrical development is in many cases detrimental to poor people who may suffer from eviction or degradation of their livelihoods.

FAQ 13.4: What kind of climate change policies and instruments would best promote poor people's ability to move out of poverty?

Climate policies that not only address mitigation or adaptation but also the underlying structural causes of poverty and inequality will be most successful for enhancing livelihood resilience and poverty reduction. This includes adaptive social protection programs that foster asset protection and promotion as well as more inclusive participation in decision-making. On the mitigation front, provision of clean energy for cooking has a large potential for reducing emissions of both greenhouse gases and aerosols (soot) from burning of biomass, coal, or animal dung. Such mitigation policies would alleviate the reproductive hardship particularly for women and provide a range of other social, environmental, and economic co co-benefits.

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Table 13-1: Progress toward the MDGs, globally and at the country level.

MDG	GLOBAL MDG PROGRESS				COUNTRY-LEVEL MDG PROGRESS			
	Improvement since 1990? *1	Distance progressed to Goal (100% = goal attained) *2	On Track? *1	Faster Progress? (2003-2008 compared to 1990-2001/12) *3	Percent of countries making progress on targets *4	Percent countries on track *4	Percent countries on track *2	Faster Progress? (2003-2008 compared to 1990-2001/12) *3
Poverty	Y	80	Y	Y	63	49	47	51
Undernourishment	Y	77	N	N	55	34	25	-
Primary Education	Y	90	N	Y	75	46	55	35
Gender Equality **	Y	96	Y	N	61	55	89/82**	46
Child Mortality	Y	69	N	Y	95	38	36	32
Maternal Mortality	Y	57	N	Y	83	19	30	-
Drinking Water	Y	88	Y	N	73	49	66	34

Source: Kenny and Sumner 2011 (*1 Kenny and Sumner (2011); *2 World Bank (year?); *3 Fukuda-Parr and Greenstein (year?); *4 Leo and

** Gender equality for primary and secondary education, respectively.

Table 13-2: Types of social protection.

Time frame	Social protection category	Social protection instruments	Role in crises and climate change adaptation
Short-term ↑ Coping ↑ Building adaptive capacity Long-term	Asset protection (social assistance)	• Social service provision • Basic social transfers (food/cash) • Pension and disability schemes	➢ Provides immediate protection and relief from poverty and deprivation ➢ Protects the most vulnerable to climate risks
	Prevention of asset erosion (insurance and diversification mechanisms)	• Safety nets • Social transfers • Public works programmes • Livelihood diversification • Weather-indexed crop insurance	➢ Prevents damaging coping strategies as a result of risks to weather-dependent and climate-sensitive livelihoods
	Asset promotion (economic opportunities)	• Social transfers • Access to credit • Asset transfers/protection • Starter packs (drought/flood-resistant) • Access to common property resources	➢ Promotes resilience through livelihood diversification and security to withstand climate-related shocks ➢ Promotes opportunities arising from climate change
	Transformation (addressing underlying social vulnerabilities)	• Promotion of minority rights • Anti-discrimination campaigns • Social funds	➢ Transforms social relations to combat discrimination underlying social and political vulnerability

Adapted after Arnall (2010) and Davies (2009).

Figure 13-1: Global distribution of poverty (MPI) as a world map, with other poverty measures (under construction).

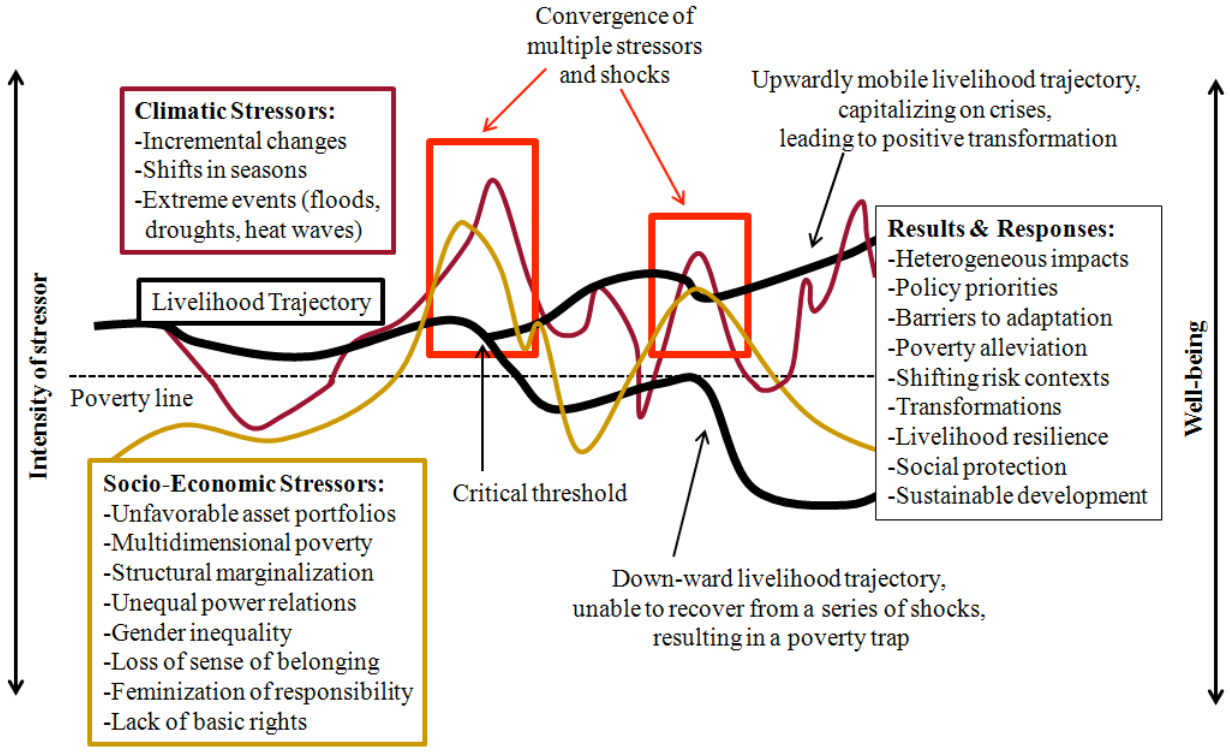

Figure 13-2: Livelihood dynamics under increasing frequency and severity of climatic stressors combined with unequally distributed socio-economic stressors, leading to differential trajectories.

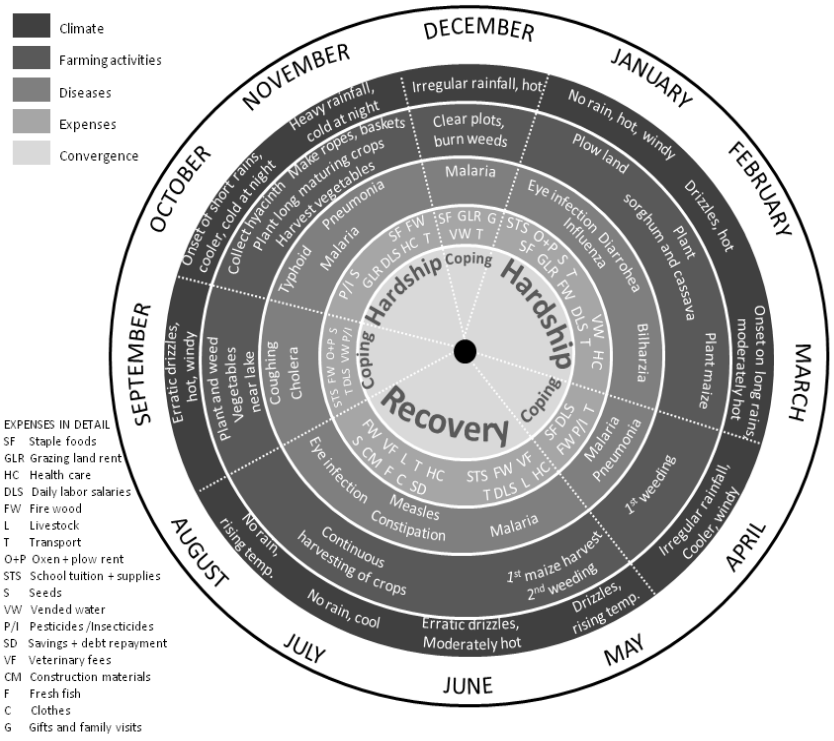

Figure 13-3: Wheel of hardship (in color in later version). Source: Gabrielsson et al. (2012).

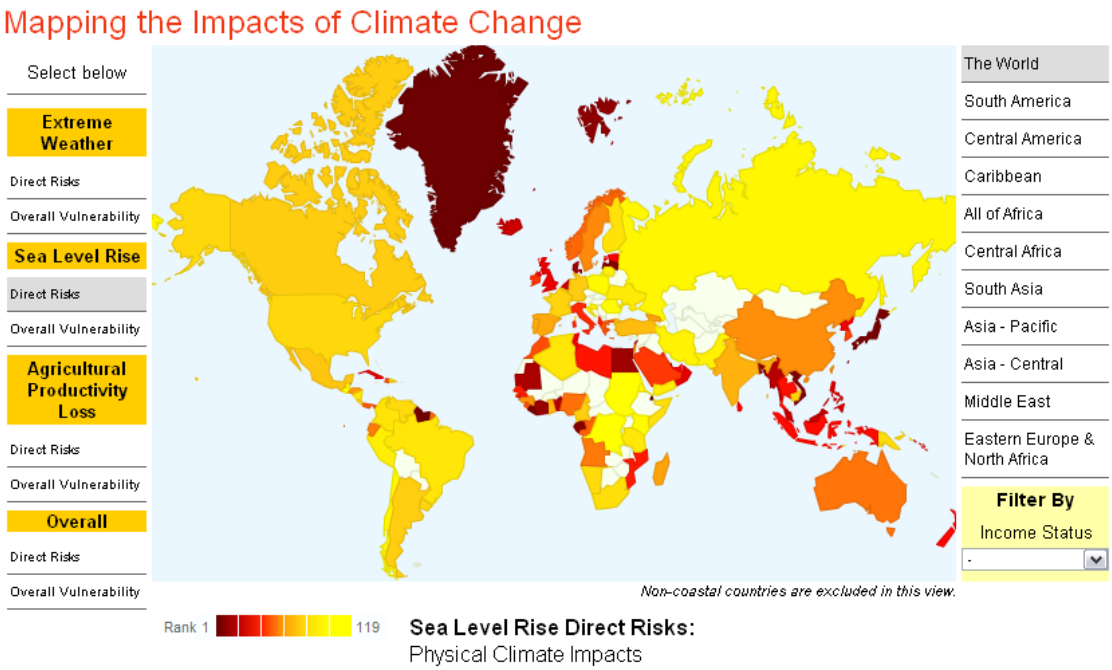

Figure 13-4: Map from Wheeler's dataset. Direct risks from sea level rise (without adaptive responses). http://www.cgdev.org/section/topics/climate_change/mapping_the_impacts_of_climate_change