THE WORKING GROUP II CONTRIBUTION TO THE IPCC'S FIFTH ASSESSMENT REPORT
Rural Chapter 9
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Below are some highlights from Chap 9. The three key concepts to study for any given area are Risk, Vulnerability and Adaptation.

9.3.5.1.3. Institutions, access to resources, and governance

Institutions and networks can affect vulnerability to climate change: through distribution of climate risks between social groups; by determining the incentive structures for adaptation responses; and by mediating external interventions (e.g. finances, knowledge and information, skills training) into local contexts (Ribot, 2010; Agrawal and Perrin, 2008). Institutions can decrease vulnerability (Anderson *et al.* 2010) or increase it (Eakin, 2005) Governance structures and communication flows as shown in a Swiss mountain region vulnerable to climate change (Ingold *et al.*, 2010) and the knowledge and perceptions of decision-makers are also important. Romsdahl *et al.* (2013) show that local government decision-makers in the US Great Plains resist seeing climate change as within their responsibilities, which has contributed to low levels of planning for either adaptation or mitigation, and thus to greater vulnerability, but that a reframing of issues around current resource management priorities could allow proactive planning.

Lack of access to assets, of which land is an important one, is accepted to be an important factor increasing vulnerability in rural people (McSweeney and Coomes 2011). The breakdown of traditional land tenure systems increases vulnerability, particularly for those who experience poorer land access as a result (Fraser *et al.*, 2011;

9.3.5.1.6. Knowledge and information

Lack of access to information and knowledge of rural people can also interact with all the above mentioned drivers to mediate vulnerability. Shared knowledge and lessons learned from previous climatic stresses provide vital entry points for social learning and enhanced adaptive capacity (Tschakert, 2007). But while some authors emphasize the need for local responses and indigenous knowledge to reduce vulnerability (Valdivia *et al.*, 2010), and call for an integration of local knowledge into climate policies (Nyong *et al.*, 2007; Brugger and Crimmins 2012), Bellon *et al.* (2011) state that local knowledge is too local, and in some contexts gathering information from further away is important.

Access to information alone is not a guarantee of success. Coles and Scott (2009) found that in Arizona, despite ample access to weather forecasting, ranchers did not rely on such information, implying that changes are required to make more attractive information to users, as well as to understand prevailing local cultures and norms.
It is also important how knowledge is produced, managed, and disseminated within the formal institutional structure to address vulnerability issues. A local case-study in Sweden shows that limited co-operation between local sector organizations, lack of local co-ordination, and an absence of methods and traditions to build institutional knowledge present barriers to manage vulnerability (Glaas *et al.*, 2010). In Benin, as elsewhere in Africa, there is a lack of co-ordination between climate policies and the policies and practices which govern agricultural research and extension, while good practice at project level has been insufficiently harnessed to foster collective learning of farmers and other agricultural stakeholders, and thus adaptation to climate change (Moumouni and Idrissou 2013a and 2013b). For institutional learning, knowledge transfer, and more reliable assessments of local vulnerabilities, local institutional structure must be flexible, establishing communication mechanisms between public authorities, other knowledge producers, and civil society (Glaas *et al.,* 2010).

Box 9-2. Tourism and Rural Areas
The three major market segments of tourism most likely to be affected by climate change are rural-based, namely, coastal tourism, nature-based tourism and winter sports tourism (Scott *et al.*, 2012). Tourism is a significant rural land use in many parts of the world, yet compared to other economic sectors in rural areas, the impacts of climate change are typically under-researched. In the Caribbean, for example, tourism has overtaken agriculture in terms of

economic importance, with several regional states (including the Bahamas, the Cayman Islands and St Lucia) receiving more than 60 percent of their GDP from this industry (Meyer, 2006). Coastal environments elsewhere in the world are also characterized by dependence on rural tourism, and are known to be vulnerable to cyclones and sea level rise (Klint *et al.,* 2012a; Payet, 2007).

Terrestrial natural resource-based tourism is also a significant foreign exchange earner in many countries. In sub-Saharan Africa, between 25 and 40% of mammal species in national parks are likely to become endangered by 2080, assuming no species migration (and 10-20% with the opportunity for migration) (Thuiller *et al.,* 2006). There are
also many rural environments viewed as "iconic" or having cultural significance that are vulnerable to climate change. In South Africa, for example, the Cape Floral (fynbos) ecosystem has a high level of species endemism which will be vulnerable to the projected increase in dry conditions (Midgley *et al*., 2002; Boko *et al*., 2007). The projected increase in climate change-related hazards, such as glacial lake outbursts, landslides, debris flows and floods, may affect trekking in the Nepali Himalayas (Nyaupane and Chhetri, 2009).

The development of tourism has, in many cases, increased levels of exposure to climate change impacts. In the Caribbean, for example, tourism has led to considerable coastal development in the region (Potter, 2000), which may exacerbate vulnerability to sea-level rise. In many cases, the carbon emissions resulting from participating in rural tourism threaten the very survival of the areas being visited. This is often the case for very remote locations, for example polar bear tourism in Canada (Dawson *et al.*, 2010), dive tourism in Vanuatu (Klint *et al.*, 2012b). Although on aggregate resource consumption of tourists and locals has been shown to be similar in developed county contexts (e.g. in Italy – Patterson *et al*., 2007); in many developing countries resource use by tourists is much higher than that of locals (e.g. in Nepal - Nepal, 2008).

Despite the potential impacts of climate change on rural tourism, there is *low evidence* of significant concern, which impedes adaptive responses. Surveys in both the upper Norrland area of northern Sweden and New Zealand showed that climate change is not perceived to pose a major threat in the short term, relative to other business risks perceived by small business owners and tourism operators (Brouder and Landmark, 2011; Hall, 2006).

That said, there is evidence that, with planned adaptation, tourism can flourish in rural areas under climate change.

In the Costa Brava region of Spain, for example, although the increasing temperatures and reduced water availability is projected to negatively impact tourism in the current high seasons, there is scope to shift to the current shoulder seasons, namely April, May, September and October (Ribas *et al.*, 2010). Recognition of the opportunities for adaptation has also necessitated reassessment of the extent of the potential impacts of climate change on the tourism industry in rural areas. With the availability of snowmaking as a (costly and uncertain) adaptation in the eastern North American ski industry, only four out of fourteen ski areas are at risk before 2029, but ten out of fourteen in the
period 2070-2099 (Scott *et al.*, 2006).

9.4.1. Framing Adaptation

AR4 stated with very high confidence that adaptation to climate change was already taking place, but on a limited basis, and more so in developed than developing countries. Since then, the documentation of adaptation in developing countries has grown *(high confidence*). Adaptation is progressive, and is distinguished from coping as it reduces vulnerability in the cast of re-exposure to the same hazard (Vincent *et al*., 2013): it can therefore be identified even without high confidence that a local hazard or climate trend is attributable to global climate change – indeed many cases of adaptation are primarily driven by other stressors, but have the result of aiding adaptation to climate change (Berrang-Ford *et al.*, 2011).

Many adaptations do build on examples of responses to past variability in resource availability, and it has been suggested that the ability to cope with current climate variability is a prerequisite for adapting to future change (Cooper *et al.*, 2008). At the same time, however, it cannot be assumed that past response strategies will be sufficient to deal with the range of projected climate change. In some cases, existing coping strategies may increase

vulnerability to future climate change, by prioritising short–term resource availability (O'Brien *et al.*, 2007; Adepetu and Berthe, 2007). In Malawi, for example, forest resources are used for coping (gathering wild food and firewood
to sell), but this process reduces the natural resource base and increases vulnerability to future flooding through reduced land cover and increased overland flow (Fisher *et al*., 2010). In developing countries, there is *high confidence* that adaptation could be linked to other development initiatives aiming for poverty reduction or improvement of rural areas (Nielsen *et al*., 2012; Hassan, 2010; Eriksen and O'Brien, 2007, section 13.4). For more information on the integration of adaptation and development in climate-resilient development pathways, see Chapter 20. In Ethiopia, for example, "low regrets" measures to respond to current variability are important to shift the trajectory from disaster-focused to longer-term vulnerability reduction (Conway and Schipper, 2011).

9.4.2. Decision-Making for Adaptation

Decision-making for adaptation takes place at a variety of levels, and can be public or private. International mechanisms variously support adaptation decision-making at all levels (see sections 14.4, 15.2). At the national and local levels, law and policies can enable planned adaptation (Stuart-Hill and Schulze, 2010). A longer history of evidence for public policies to support adaptation exists from developed countries, although increasingly developing countries are also introducing such policies (for more information see section 15.2; and Box 25-2 for information on Australia's water policy and management, section 26.9.1 for information on federal adaptation policies in the USA and Canada). At local level, some progress towards adaptation planning has been observed, particularly in developed countries. In Australia, for example, Western Australia, South Australia and Victoria have mandatory State planning benchmarks for 2100 (see Box 25-1), and in the Great Plains of the US, some jurisdictions have developed plans on either climate adaptation or climate mitigation, although so far less than 20% have done so (Romsdahl *et al.*, 2013).

At the local level, many adaptations are examples of private decisions for adaptation, undertaken by NGOs (primarily in developing countries, often in the form of community-based adaptation), and companies and individuals. Public and private decision-making for adaptation is not always mutually exclusive: one example of where policy can support private adaptation is in the provision of index-based insurance schemes (Suarez and Linnerooth-Bayer, 2010; Linnerooth-Bayer and Mechler, 2007), which have variously been trialed in India, Africa and South America (Patt *et al*., 2010; Patt *et al*., 2009; for a case study on index-based weather insurance in Africa see Box 22-1). However, national policies and laws are not always mutually-supportive of private actions (Stringer *et al.*, 2009).

There is now *high confidence* that public decision-making for adaptation can be strengthened by understanding the decision-making of rural people in context, and in particular considering examples of autonomous adaptation and the interplay between informal and formal institutions (Eakin and Patt, 2011; Naess, 2012; Adhikari and Taylor, 2012; Bryan *et al.*, 2009). Adaptation can also build upon local and indigenous knowledge for responding to weather events and a changing climate as has been observed in Samoa (Lefale, 2010 – see chapter 29), the Solomon Islands (Rasmussen *et al*., 2009 – see chapter 29), Namibia (Newsham and Thomas, 2011), Canada (Nakashima *et al*.,
2011-see chapter 24), the Indo-Gangetic Plains (Rivera-Ferre *et al*., 2013b), and Australia (Green *et al*., 2010)

*9.4.3.1. Agricultur*e

Agricultural societies have a history of responding to the impacts of change in exogenous factors, including (but not limited to) weather and climate (Mertz *et al.*, 2009a). They undertake a range of adjustment measures relating to their farming practices – for example, planting, harvesting and watering/fertilizing existing crops; using different varieties, diversifying crops; implementing management practices such as shading and conservation agriculture. Table 9-7 gives some examples; Box 9-3 describes adaptation initiatives in the beverage crop sector: more information on agricultural adaptation is available in Sections 23.8.2 (Europe), 24.4.3.5 (Asia), 25.7.2 (Australasia), 26.5.4 (North America), 27.3.4.2 (Central and South America).

[INSERT TABLE 9-7 HERE
Table 9-7: Examples of adaptations in the agricultural sector in different regions.]

Conservation agriculture shows promising results and can be used as an adaptation (Speranza, 2013) and for sustainable intensification of production (Pretty *et al.*, 2011), with significant yield productions observed in South Asia and southern Africa (Erenstein *et al.*, 2012). See Box 22-2 for a case study on integrating trees into annual

cropping systems. Water management for agriculture is also critical in rural areas under climate change, for example the use of rainwater harvesting (Kahinda *et al.*, 2010, Vohland and Barry, 2009; Rivera-Ferre *et al.*, 2013b), and more efficient irrigation, particularly in rural drylands (Thomas, 2008).

Adaptations are also evident among small-scale livestock farmers (Rivera-Ferre and López-i-Gelats, 2012; (Kabubo- Mariara, 2009, 2008), who use many different strategies, including changing herd size and composition, grazing and feeding patterns, or diversifying their livelihoods, also they may use new varieties of fodder crops suited to the changing conditions (Salema *et al.*, 2010).

Diversified farms are more resilient than specialized ones (Seo, 2010); but rural societies also diversify their income sources beyond agriculture, which in many contexts allows them to reduce their risk exposure. Examples include the exploitation of gums and resins in Kenya (Gachathi and Eriksen, 2011).There may be some rural areas, however, where limits to agricultural adaptation are reached, and thus the only option that remains is to migrate or diversify away from farming (Mertz *et al.*, 2011). According to chapter 7, adaptation leads to lower reductions in food production with more effective adaptation (of around 15-20% compared with no adaptation), and adaptations are more successful at higher latitudes (for maize, wheat and rice) than in tropical regions. Figure 7-8 shows the varying efficiency of different crop adaptation measures, with cultivar adjustment leading to the largest percentage difference from the baseline, compared with irrigation optimization and planting date adjustment (although this shows the largest variation).

Box 9-3. Adaptation Initiatives in the Beverage Crop Sector

One of the leading initiatives to prepare small holder producers of beverage crops for adaptation to climate change is the AdapCC project which worked with coffee and tea producers in Latin America and East Africa (Schepp, 2010). This process used risk and opportunity analysis and participatory capacity building (CafeDirect/GTZ, 2010) to help farmers identify changes in management practices to both mitigate their contribution to climate change and adapt to the changes in climate they perceived to be occurring. In general the actions for adaptation were a reinforcement of principles of sustainable production, such as using tree shade. Facilitating processes of adaptation in the context of strong variability in vulnerability between different communities in the same region and even families within the same community (Baca 2011) will be a challenge, but supports the need for participatory community adaptation processes that would enable families to implement strategies appropriate to their own circumstances and capacity.

Policy recommendations to support adaptation in these sectors (Eakin *et al.*, 2011; Laderach *et al.*, 2010 Schepp, 2010; Schroth *et al.*, 2009) have prioritized the follows interventions to support adaptation:

- Community-based analysis of climate risks and opportunities as a basis for community adaptation strategies
- Improved recording and access to climate information including medium and long-term predictions
- Sustainable production techniques including soil and water conservation, shaded production systems, diversification of production systems
- Development of new varieties with broader adaptability to climate variation, higher temperatures and increased drought tolerance
- Financial support to invest in adaptation and reduce risks through climate insurance
- Organization of small producers to improve access to knowledge, financial support and coordinate implementation
- Environmental service payments and access to carbon markets to support sustainable practices
- Development of value chain strategies across all actors to support adaptation and increase resilience across the sectors.

FAQ 9.2: What will be the major climate change impacts in rural areas across the world?
[to be placed in Section 9.3.3.4]

The impacts of climate change on patterns of settlement, livelihoods and incomes in rural areas will be complex and will depend on many intervening factors, so they are hard to project. These chains of impact may originate with extreme events such as floods and storms, some categories of which, in some areas, are projected with high confidence to increase under climate change. Such extreme events will directly affect rural infrastructure and may cause loss of life. Other chains of impact will run through agriculture and the other ecosystems (rangelands, fisheries, wildlife areas) on which rural people depend. Impacts on agriculture and ecosystems may themselves stem

from extreme events like heat waves or droughts, from other forms of climate variability, or from changes in mean climate conditions like generally higher temperatures. All climate-related impacts will be mediated by the vulnerability of rural people living in poverty, isolation, or with lower literacy etc., but also by factors that give rural communities resilience to climate change, such as indigenous knowledge, and networks of mutual support.

Given the strong dependence in rural areas on natural resources, the impacts of climate change on agriculture, forestry and fishing, and thus on rural livelihoods and incomes, are likely to be especially serious. Secondary (manufacturing) industries in these areas, and the livelihoods and incomes that are based on them will in turn be substantially affected. Infrastructure (e.g. roads, buildings, dams and irrigation systems) will be affected by extreme events associated with climate change. These climate impacts may contribute to migration away from rural areas, though rural migration already exists in many different forms for many non-climate-related reasons. Some rural areas will also experience secondary impacts of climate policies – the ways in which governments and others try to reduce net greenhouse gas emissions such as encouraging the cultivation of biofuels or discouraging deforestation. These secondary impacts may be either positive (increasing employment opportunities) or negative (landscape changes, increasing conflicts for scarce resources).

FAQ 9.3: What will be the major ways in which rural people adapt to climate change?
[to be placed in Section 9.4.4]

Rural people will in some cases adapt to climate change using their own knowledge, resources and networks. In other cases governments and other outside actors will have to assist rural people, or plan and execute adaptation on a scale that individual rural households and communities cannot. Examples of rural adaptations will include modifying farming and fishing practices, introducing new species, varieties and production techniques, managing water in different ways, diversification of livelihoods, modifying infrastructure, and using or establishing risk sharing mechanisms, both formal and informal. Adaptation will also include changes in institutional and governance structures for rural areas.