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Dedicated to the people of Bhutan -
in pursuit of gross national happiness
for a climate resilient future

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1. Research approach

Climate change increasingly gains significance in social and cultural anthropological research. Climate science and political decisions on mitigation of anthropogenic climate change and on adaptation to its impacts, as well as global economic practises further aggravating or reducing fossil fuel use and greenhouse gas emissions are linked to anthropological topics such as sustainable development of communities, equitable use of natural resources and ecosystem services, political and social justice, gender equality, social participation, indigenous knowledge, human rights, food security, conflicts, and migration.

Existing economic, political and humanitarian stresses and social vulnerabilities can be intensified by climate change. Thus, in development planning, taking into consideration the interlinkage between climate change mitigation and adaptation is crucial, as long-term adaptation only can be achieved in a sustainable way if essential mitigation measures happen simultaneously.

In the first part, the thesis conducts a review on the positioning of climate change in social and cultural anthropology and explores potential roles of anthropologists as communicators. The thesis further outlines the global phenomenon of climate change including a focus on the Himalayan region and the Kingdom of Bhutan, the core areas of climate change mitigation and adaptation, international politics, scientific consensus, and climate change denial. Moreover, the thesis explores the need of synergies between climate and development agendas in terms of better integrated policies on climate change and on socio-economic development. The perspective that the “discussion regarding development policies as a vehicle for concrete climate action is right at the centre of the current policy debate” (Román et al. 2012: 258) supports the relevance of this research approach.

In Bhutan, climate change impacts have been observed. The political commitment of the Royal Government of Bhutan that the country will remain carbon neutral has been internationally acknowledged. Bhutan is contributing to mitigate climate change focusing on carbon sequestration by its vast forests covering around seventy percent of the country and on hydropower generation as clean renewable energy.

In the second part of the thesis, the qualitative research focuses on local development planning in the context of climate change in Bhutan. The research was supported by a study visit to Bhutan from 1 March to 15 May 2015 with affiliation to the Council for Renewable Natural Resources Research in Bhutan (CoRRB), Ministry of Agriculture and Forests (MoAF), Royal Government of Bhutan. Thematic discussions with MoAF, CoRRB, the National Environment Commission, Gross National Happiness Commission, and Department of Local Governance under the Ministry of Home and Cultural Affairs and research on official documents provided the basis for the analytical part. The study also builds on professional experience in international development cooperation in the Himalayan region, specifically four years of work and residence in Bhutan and two years in Nepal with focus on local governance and on rural livelihoods and ecosystem services in the context of socio-economic and climate change.

Introductorily, international obligations of Bhutan related to environment and climate change, institutional setup and governance structures, and history of and social participation in development planning are documented. In line with the underlying research question how climate change is reflected in the political development framework of Bhutan, the analytical part of research firstly explores national laws, policies, and sectoral development programmes on their relevance for climate change mitigation and adaptation. Cross-sectoral significance of climate change related measures and interdependences of different sectors for sustainable and climate resilient development are identified. Secondly, this research conducts an analysis of the current development plan of the country, the Eleventh Five Year Plan 2013-2018, on inclusion of climate change mitigation and adaptation measures at the national and sectoral level, and at the local level of the twenty dzongkhags (districts) of Bhutan.

The document analysis with regard to contents of climate change adopts the double approach of analysing in what context climate change is mentioned explicitly, and of analysing content without explicit reference to climate change but with significant relevance for climate change. For this purpose, three key categories for content analysis are identified: relevance for impacts of climate change, relevance for mitigation of climate change, and relevance for adaptation to climate change.

2. Positioning of climate change in social and cultural anthropology

Contemporary anthropological climate research has its seeds in early environmental anthropology and archaeology from the 1960s onwards, as Crate in her 2011 article on climate and culture in *Annual Review of Anthropology* has pointed out: “On a deep time scale, archaeologists have a strong history of investigating climate change and its relationship with cultural dynamics - resilience and decline, florescence and social structure” (Crate 2011: 177). Researching the linkages between culture and ecology shows “how cultures attribute meaning and value to their interpretations of weather and climate and how people have achieved and continue their adaptation to local climate, temperature, flooding, and rainfall” (Crate 2011: 178).

2.1. Human influence

Compared to anthropological research questions how climate, weather, seasonality, environment, and natural disasters had influenced social and cultural life, nowadays “the polarity is reversed. It is human habits and social life that dramatically, perhaps irreversibly, affect climate, seasons, and weather” (Howe 2015: 206). Climate change emerged as a relevant contemporary field for anthropologists looking into “climatological commons”, as people have become more “conscious climate inhabitants living within weather-weathered political economies” (Howe 2015: 207).

Acknowledging that climate has impacts on human behaviour, while at the same time, people are able to cause changes of global climate, Peterson and Broad perceive the “territory for anthropological exploration” (Peterson; Broad 2009: 70). Together with the environment, cultural, social and economic lives are intrinsically tied to climate conditions and changes. This perception focuses research “on both the global nature of anthropogenic climate change and the production and distribution of forms of scientific knowledge” (Peterson; Broad 2009: 71), dealing with socio-cultural adaptation to an uncertain future of global warming. Beyond the local nature of climate experiences of communities and in view of the global scale of human induced climate change, current climate anthropology also examines “the role of power and inequalities in the effects of and responses to climate change” (Peterson; Broad 2009:

75) in its efforts to critically engage anthropology with contemporary climate discourse.

It is common scientific consensus that climate change is unequivocal due to the evidence of increasing global air and ocean temperatures, melting snow and ice cover, and rising sea levels, and that present rapid global warming is caused by human activities, mainly the emission of greenhouse gases. While weather patterns become more unpredictable extreme events such as heavy precipitation, floods, storms, or heat waves occur more frequently. Furthermore, global warming and rising sea levels due to anthropogenic causes will continue for centuries due to long-term climate processes (IPCC 2007: 30, 46). Though climate change is broadly recognised as a global challenge, “responses to it have so far been overly focused on scientific and economic solutions, rather than on the significant human and gender dimensions” (Skinner 2011: 1).

The responses of countries to climate change depend on their political, economic, social, cultural and environmental circumstances and on available knowledge, technologies, and financial means. Access to information on climate change based on credible sources is essential for building climate change information management systems at the political level. Conceptualising information contents into local contexts, analysing potential impacts, transferring the knowledge to local government and community levels, and implementing social participation systems for discussing and deciding potential adaptation measures at the local level are key aspects and responsibilities of national politics. Particularly the agriculture sector can benefit from an improved climate change information management system, thus contributing to enhance livelihoods of rural communities and food security.

2.2. Social and environmental implications

A social scientific perspective can facilitate a better understanding of roles and agency of people and institutions dealing with climate change mitigation and adaptation. Mitigation aims at reducing the exposure to climate change, while adaptation aims at reducing the vulnerability of communities to occurring changes due to global warming. Mitigation and adaptation need to be understood as complementing human activities

necessary to combat the multifaceted looming dangers of anthropogenic climate change, as “neither adaptation nor mitigation alone can avoid all climate change impacts” (IPCC 2007: 65).

Irreversible changes in regional climate are causing multiple stresses for people and environment, like melting glaciers, rising sea levels, increasing floods, droughts and heat waves, ocean acidification, desertification, spread of vector-borne diseases, and loss of biodiversity and species. Some species are shifting their habitat to more favourable areas, others without alternative habitat will face extinction, and invasion of species from lower elevations will appear all causing potential consequences for pastoral communities. On the long term, some species’ adaptability could undergo evolutionary modifications to cope with new environmental conditions, provided that they can keep up with anthropogenic climate change at an accelerated pace.

Changing climate together with biodiversity loss also negatively affects manifold ecosystems which provide a wide range of resources and benefits for people. These so called ecosystem services support life on earth with photosynthesis and nutrient cycling; regulate climate, air quality, water sources, soil cover, pests and diseases and enable the growth of a variety of crops through pollination; supply products like food, natural medicines, and freshwater; and offer options and space for cultural practises and recreation (National Research Council 2013: 128). On the other side, ecosystems also are the basis for energy production, be it from fossil fuels like coal, petroleum, and natural gas, or renewable energy mainly from hydropower, solar energy, wind, and biomass.

Disruptive events of the living conditions of communities like natural disasters always have been part of social research. Nowadays, impacts of climate change on the environment, the livelihood, and the socio-cultural identity of communities are visible to contemporary anthropologists in the field. Consequently, researchers frame their studies within the increasing discourse on climate change to capture the social and cultural dimensions of a changing environment, and the options and capacities how to adapt to it. These significant changes for people, already occurring and predicted in an even bigger scale for the future, indicate how important it has become to study their implications for communities. All the more, as the traditional knowledge and adaptive

capacity of local communities might not suffice any longer in view of climate change. In mitigation and adaptation planning, additional to scientific evidence, underlying value judgements according to the different social-cultural backgrounds of social actors have to be considered as well.

2.3. Anthropological discourse

What anthropology can bring into climate research is “its core theoretical tenet: that culture frames the way people perceive, understand, experience, and respond to key elements of the worlds which they live in” (Roncoli et al. 2009: 87). Contributing to interdisciplinary perspectives of climate studies anthropology can provide “the description and analysis of these mediating layers of cultural meaning and social practice” (Roncoli et al. 2009: 87).

Compared to the widespread view of climate change purely from a natural scientific or technical perspective “climate change is also a social, economic and political phenomenon with profound implications for social justice and gender equality” (Skinner 2011: 1). Current anthropological research contributes towards an “enhanced understanding of the relationship between climate change and the key social dimensions of vulnerability, social justice, and equity” (Mearns; Norton 2010: 1). This reveals that “causes and consequences of climate change are intertwined deeply with global patterns of inequality. Climate change acts as a multiplier of existing vulnerabilities in a warming and transforming world” (Mearns; Norton 2010: 2). Existing economic, political and humanitarian stresses can be intensified by climate change. The sustainability of livelihoods of communities can be appalled, risks of conflicts over scarce natural renewable resources and increased migration movements might occur.

Linking climate change to human rights the Human Rights Council (HRC) in 2008 expressed its concern “that climate change poses an immediate and far-reaching threat to people and communities around the world and has implications for the full enjoyment of human rights” (HRC 2008: 1). This includes the right to development intending “to equitably meet the development and environmental needs of present and future generations” (HRC 2008: 2). In this context, HRC also recognises the specific

vulnerability of developing countries with fragile mountainous ecosystems to negative impacts of climate change. By highlighting the importance of environment for sustainable development, particularly adequate housing and access to water, the link of protecting environment in the context of climate change and the enjoyment of human rights is clearly established (HRC 2008: 2).

The United Nations Development Programme (UNDP) in its 2014 Human Development Report even states: “Environmental degradation and climate change threaten the long-term survival of humanity” (UNDP 2014: 44). Thus, in the context of climate change, ensuring sustainable human development needs to address “the underlying causes of vulnerability, including the structural inequalities that create and sustain poverty and constrain access to resources” (UNDP 2014: 52).

“Framing climate change as an issue of social justice” (Mearns; Norton 2010: 5) firstly points at the “global injustice of a world in which responsibility for the causes of climate change is inversely proportional to the degree of vulnerability to its consequences” (Mearns; Norton 2010: 2). This raises questions of equity and social justice between countries emitting the bigger part of greenhouse gases and countries facing worse effects of global warming; between different social groups within countries considering situations of social differentiation, discrimination, and exclusion; and between generations, as present actions on climate change substantially impact future generations.

Climate change is challenging national development agendas and needs to be incorporated into policies and plans of poverty alleviation and sustainable development. “A social justice perspective emphasizes that those whose lives and livelihoods are most vulnerable to the consequences of climate change and who have contributed the least to its causes should receive preferential support” (Mearns; Norton 2010: 10). What can be called pro-poor adaptation means reducing poor people’s vulnerability to negative effects of climate change and synchronising “climate action with other social goals, such as poverty alleviation, gender balance, and empowerment” (Heltberg et al. 2010: 260).

As the livelihood of communities dependent on natural resources and surrounding ecosystems, and therefore on local climate patterns, will be most affected, integrating

adaptation into development agendas also needs to include social protection, enhancement of sustainable livelihoods, and disaster risk reduction. Increasing climate volatility causes increasing threats to poor households lacking resources and assets to deal with extreme weather events. This again will show long-term poverty implications including “destitution, landlessness, asset loss, irreversible malnutrition, child labor, and withdrawal from schooling” (Heltberg et al. 2010: 262). Additionally, if public aid, community based saving networks, or microfinance institutions are not available, poor households face high risks of getting into debt to private money lenders charging exploitative interest rates.

Anthropological field research increasingly points out that the “community is the vital level for action to adapt to and meet climate change”, while at the same time, “climate change and its physical consequences do not respect national borders so policy and action to address the problem must be developed internationally” (Smith; Vivekananda 2007: 23). Analysing “situational drivers of vulnerability” will help to better “understand the different ways people are vulnerable to the consequences of climate change by virtue of their geographic locations, livelihood sources, asset holdings, and social positioning; and the need to understand the implications for the appropriate tailoring of operational and policy responses in developing countries” (Mearns; Norton 2010: 5). In this context it is noted, that cultural perspectives emphasising solidarity and mutually beneficial collaborative approaches can be supporting elements for the adaptive capacity of communities.

While participatory approaches in community interactions are well established, social dynamics of meetings “centered on public speaking and visible performance, tend to privilege the views and voices of the most prominent or educated members of the community” (Roncoli 2006: 83). To avoid at the best that “subordinate groups may be held back by internalized cultural norms or fear of retribution”, examining “the power relations that underpin differences in vulnerability” (Roncoli 2006: 83) will be essential to support more inclusive ways of social participation.

2.4. Gender relations

From a gender perspective, power structures and power distribution need to be addressed in terms of underlying gender relations. In order to adopt gender-sensitive strategies it will be essential that “gender differences, being a key component of the political, social, economic and cultural characteristics of a society, need to be considered as a strategic entry point for identifying roles and responsibilities within a community” (Lambrou; Piana 2006: 23). When climate change multiplies existing vulnerabilities, as noted earlier, particularly existing gender inequalities can be fortified as well. Demetriades and Esplen state that “it is generally recognized that pervasive gender inequalities in societies throughout the world give rise to higher rates of poverty among women” (Demetriades; Esplen 2010: 133).

Lack of access to resources and technologies, information and education, health care and other community services, and less participation in decision-making processes additionally weaken the capacity of women for adaptation to climate change. For example, land ownership, pivotal for rural households, also serves as security for financial loans. Where women are restricted to own land and therefore not granted loans by banks, female farmers face difficulties to purchase required varieties of seeds and livestock for particular climatic conditions, or adapted agrarian technologies for improving crop and soil quality and post-harvest storage. These problems are exacerbated by male outmigration for income generation in the case where women stay back in the villages taking over additional agricultural responsibilities and workload traditionally performed by men.

Deepened social research on gender differentiated impacts of global climate change will also contribute to better integrate gender considerations in response strategies, taking “gender-specific differences in adaptive and mitigative capacity” (Lambrou; Piana 2006: 2) into account. Approaches to mainstream gender in responses to climate change will require “promoting a shift from a special focus on women to the adoption of a broader gender approach, based on the relations between men and women” (Lambrou; Piana 2006: 20). Furthermore, overlapping social topics of development and climate change agendas could be better synchronised stipulated that an “active dialogue between the development and the climate policy communities should

address much more the deep linkages between development, poverty eradication and climate protection” (Lambrou; Piana 2006: 2).

Moreover, gender disaggregated assessments of vulnerability are also essential in the context of disaster risk reduction and disaster management. Possible social constraints of female skills, for instance where social prejudices prohibit girls and women from physical practices like swimming and tree climbing, which can be survival skills in the event of flooding, and of mobility to cope during disasters need to be taken into consideration. In the aftermath of disasters high stress levels, insecurity, and lack of privacy can create emotional states of fear, enragement, and frustration. This can trigger situations of violence and especially the risks that “women and girls are more likely to become victims of domestic and sexual violence after a disaster, particularly when families have been displaced and are living in overcrowded emergency or transitional housing” (Brody et al. 2008: 7).

Linking the widespread absence of gender issues in climate policies to the “relative absence of social, behavioral and justice issues in general in the climate dialogue”, a 2008 United Nations (UN) working group report already stated that “gender-sensitive methods of problem analysis, situation description and impact assessment need to be developed for climate change” (Aguilar et al. 2008). Addressed to the UN secretary general, the report recommends to “hold the scientific community and governments accountable for the deployment of gender mainstreaming as a crucial key to unlocking the talents and capacity of men and women to fully exploit opportunities for adaptation, mitigation and sustainable development” (Aguilar et al. 2008).

From a social science perspective it is essential to link a thoroughly differentiated perception of vulnerability to climate science and to policy development on mitigation and adaptation to facilitate that political responses are gender balanced formulated and consider potential effects on particularly vulnerable groups like the poor and marginalised social strata. However, it seems to be appropriate not to treat potentially vulnerable groups as sheer victims and beneficiaries but rather as agents with own knowledge and capability to contribute to adaptation solutions.

2.5. Indigenous knowledge and social participation

In the context of rural communities, analyses of indigenous knowledge of seasons based on observations of local environment and weather patterns, and of the influence of cropping cycles on sequences of rural farm work and cultural practises can elucidate the understanding of climate from a cultural perspective. Using the simple example of rainfall forecasts, Roncoli points at different cognitive frameworks of farmers and climate scientists. The “importance of the duration of the rainy season (e.g. timing of onset and end of the rainy season) and the distribution of rainfall during the season” (Roncoli 2006: 84) is of high priority for agricultural communities. While “climate forecasts continue to be formulated in terms of quantity rather than temporal parameters”, farmers on the other hand “think about rainfall as a process rather than as a quantity” (Roncoli 2006: 84). The breakdown of large-scale regional climate change impact analyses into the plurality of local coherences yet remains another challenge.

Widening the perspective from local field research with communities to the global phenomenon of climate change Crate introduces the term “climate ethnography” to foster a more “multisited, critical collaborative ethnography”, understanding itself as an “ethnography for the world” (Crate 2011: 185). By engaging multiple stakeholders this approach of climate ethnography intends to “track how global processes are being articulated via local knowledge systems to elucidate the convergences and conflicts between the global to local conversations and understandings about climate change” (Crate 2011: 186).

In-depth research with local communities can analyse and communicate existing best practice examples on adaptation to climate change. Given their qualitative methods of participating observation and longer duration of stays, and being familiar with social and cultural practises of communities, anthropologists appear as competent researchers in this field of human responses to climate change. From this angle researchers can support processes “that respond to local realities while feeding into a broader vision of climate change deceleration” (Brody et al. 2008: 2), thus fostering beneficial cooperation between social researchers, development practitioners, and politicians.

2.6. Anthropologists as communicators

Calling for a broader public engagement of anthropologists and based on the opinion that public discussions are essential for democratic societies, Barth in an interview with Borofsky in 2001 urges anthropologists to publicly speak up on important issues people are engaged with. Barth highlights the importance of “presenting a view, a voice, on issues because that may influence public policy” (Public Anthropology 2001). Claiming advocacy by scientists, Crate intends to “move anthropologists conducting research with indigenous communities and global climate change from impartial observers into the realm of action-oriented researchers” (Crate 2008: 571). Crate identifies key roles of anthropologists as “communicators” on relevant information about climate change to communities, and “facilitators of advocacy” who are “seeking out the local, regional, and national channels to express local concerns and inform policy” (Crate 2008: 574).

Anthropologists have the capacities to link the knowledge from local research to studies on regional and global climate effects, thus interpreting and incorporating the complex social dimensions into the complexity of climate science. On the other hand, climate science, especially concrete impacts of global warming and potential options for adaptation, needs to be translated from the international level of politics, conferences and science papers into the regional and local context of communities facing effects of climate change.

By using generally understandable language and descriptions the participation of local communities needs to be ensured in planning changes in their life. As Smith and Vivekananda have pointed out, “local knowledge alone is not enough because climate change throws up unprecedented problems, but nor is the best hard science enough by itself, because adaptation needs to be locally grounded and culturally appropriate” (Smith; Vivekananda 2007: 32). Social scientists involved in the field therefore can familiarise themselves with relevant findings of climate science, aim for knowledge transfer via appropriate translation and communication, and contribute to effective transdisciplinary collaboration bridging different languages of science.

Shaping these approaches as gender-sensitive will encourage the design of policies ensuring that “women and men have an equal voice in decision-making on climate

change and broader governance processes and are given equal access to the resources necessary to respond to the negative effects of climate change” (Skinner 2011: 1). Thus, in the spirit of applied science, the analysis of gender roles within the climate change discourse can contribute to design more equitable and hence more effective climate change policies. Furthermore, anthropologists can support to strengthen processes and institutions with “a gender-aware approach that contributes to gender and social transformation” (Skinner 2011: 4). Supporting social changes of transforming discriminatory cultural and social practises into equal participation of women and men in decision-making processes yet remains a challenge. All these approaches open windows of opportunity for anthropologists in the age of climate change.

3. Climate change

3.1. General observations

Climate change, global warming, and growing stress on environment and ecosystems due to human activities like fossil fuel burning, greenhouse gas emissions, land use, and deforestation are causing visible impacts like decreasing glaciers and snow cover, increased evaporation, more severe storms, droughts, forest fires, flash floods and increased downstream run off water, loss of biodiversity and species, land degradation and desertification, air pollution, increased carbon dioxide in the atmosphere, more ultraviolet radiation, sea level rise, water pollution, acidification of oceans and growing algal bloom.

Impacts on subsistence agricultural farming, rain-fed agriculture, and water resources are of particular concern for sustainable livelihoods of rural communities. However, a warming climate will also imply beneficial impacts in some regions, as agricultural productivity can increase throughout mid latitude landscapes.

Existing economic, political and humanitarian stresses can be intensified by climate change. For instance, water scarcity problems in some regions can be aggravated causing reduced access to safe drinking water and irrigation for agriculture. Multiple stresses of changing climate are observed including impacts on human health, as

tropical and subtropical vector-borne diseases like malaria and dengue fever are moving towards warming temperature zones.

A brief overview of climate change, its evidence, causes and impacts is provided by the Royal Society and the US National Academy of Sciences, written by a joint team of leading climate scientists from both national science academies of the United Kingdom and the United States of America: “Greenhouse gases such as carbon dioxide (CO₂) absorb heat (infrared radiation) emitted from Earth’s surface. Increases in the atmospheric concentrations of these gases cause Earth to warm by trapping more of this heat” (Royal Society; NAS 2014: 2). Since the so called industrial revolution starting in the second half of the eighteenth century the burning of fossil fuels has become the major cause of emitting carbon dioxide and its concentrations in the atmosphere have increased by around forty percent, “with more than half the increase occurring since 1970. Since 1900, the global average surface temperature has increased by about 0.8 °C (1.4 °F). This has been accompanied by warming of the ocean, a rise in sea level, a strong decline in Arctic sea ice, and many other associated climate effects” (Royal Society; NAS 2014: 2).

If human activities were to continue without significant changes towards low carbon economies, “continued emissions of these gases will cause further climate change, including substantial increases in global average surface temperature and important changes in regional climate. The magnitude and timing of these changes will depend on many factors, and slowdowns and accelerations in warming lasting a decade or more will continue to occur. However, long-term climate change over many decades will depend mainly on the total amount of CO₂ and other greenhouse gases emitted as a result of human activities” (Royal Society; NAS 2014: 2).

3.2. Definition of climate change

In this thesis climate change is understood as per the United Nations Framework Convention on Climate Change (UNFCCC) definition meaning “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (UNFCCC 1992: 7).

The United Nations Framework Convention on Climate Change (UNFCCC) is a direct outcome of the United Nations Conference on Environment and Development (Rio Earth Summit) from 4 to 14 June 1992 at Rio de Janeiro, Brazil. At the same time two other thematically interlinked United Nations conventions were initiated, namely the Convention on Biological Diversity and the Convention to Combat Desertification. So far 196 parties (195 nations and the European Union) have ratified UNFCCC and are called Parties to the Convention.

This definition of the term climate change differs from the usage by the Intergovernmental Panel on Climate Change (IPCC) referring “to any change in climate over time, whether due to natural variability or as a result of human activity” (IPCC 2007: 30). Accordingly IPCC is analysing human and natural drivers of climate change.

The Intergovernmental Panel on Climate Change (IPCC) was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organisation (WMO) in 1988 to promote international scientific cooperation on climate change. IPCC’s main task is to prepare assessment reports about the state of knowledge on climate change and its potential environmental and socio-economic impacts, with contributions of hundreds of scientists around the world. As an intergovernmental body the organisation is open to all member countries of the United Nations (UN) and WMO. Currently, 195 countries are members of IPCC. Since its establishment in 1988 IPCC until 2015 has prepared five comprehensive assessment reports (IPCC 1).

3.3. Scientific consensus

It is common scientific consensus that climate change caused by human activities is observed additionally to a variability of climate caused by natural coherency over long time periods in the history of planet earth. Furthermore, the consensus comprehends that warming of the climate system is unequivocal and occurring mainly due to emissions of greenhouse gases caused by human activities, and that it is high time to combat the multifaceted negative consequences of anthropogenic climate change.

In its Third Assessment Report on Climate Change published in 2001 the Intergovernmental Panel on Climate Change (IPCC) provided an overall assessment of scientific publications on climate change, summarising the state of scientific

knowledge on global warming at that time and building on improved analysis and comparison of a growing number of data from different sources. The IPCC report shows strong evidence that most of the warming observed over the last fifty years is attributable to human activities. The report predicts that throughout the twenty-first century anthropogenic activities will continue to alter the global climate. Among the key findings are that over the twentieth century the average temperature of the earth's surface has increased by about 0.6 degrees Celsius (°C) while in the lowest eight kilometres of the atmosphere temperatures have risen as well during the past four decades; that snow and ice cover have decreased; and that ocean temperatures have increased and average sea levels have risen globally between 0.1 and 0.2 metres. The report further states that the "atmospheric concentration of carbon dioxide (CO₂) has increased by 31% since 1750"; and that "about three-quarters of the anthropogenic emissions of CO₂ to the atmosphere during the past 20 years is due to fossil fuel burning. The rest is predominantly due to land-use change, especially deforestation" (IPCC 2001: 7).

Based on this IPCC Third Assessment Report on Climate Change the scientific journal *Science* in its editorial on 18 May 2001 published a statement called 'The Science of Climate Change', jointly prepared by the seventeen science academies of Australia, Belgium, Brazil, Canada, the Caribbean, China, France, Germany, India, Indonesia, Ireland, Italy, Malaysia, New Zealand, Sweden, Turkey, and The United Kingdom. The statement confirms that IPCC's work "represents the consensus of the international scientific community on climate change science" and recognises IPCC "as the world's most reliable source of information on climate change" (*Science* 2001).

Urging all nations "to take prompt action to reduce the causes of climate change, adapt to its impacts and ensure that the issue is included in all relevant national and international strategies" (Joint science academies' statement 2005: 2) was the key message of eleven national science academies comprising the economically important Group of Eight (G8) nations Canada, France, Germany, Italy, Japan, Russia, the United Kingdom, and the United States, plus Brazil, India, and China, who are counting to the largest emitters of greenhouse gases among the emerging countries. Recognising the international scientific consensus of IPCC the joint science academies' statement on

global response to climate change, signed in 2005, highlights that the “scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action” (Joint science academies’ statement 2005: 1).

IPCC in its Fourth Assessment Report on climate change published in 2007 underlines that since the publication of its last assessment report in 2001 “progress in understanding how climate is changing in space and time has been gained through improvements and extensions of numerous datasets and data analyses, broader geographical coverage, better understanding of uncertainties and a wider variety of measurements” (IPCC 2007: 30). The report confirms that “warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level” (IPCC 2007: 30). The IPCC report further predicts that global warming and rising sea levels due to anthropogenic causes would continue for centuries due to long-term climate processes, even if the concentration of greenhouse gases in the atmosphere would be stabilised (IPCC 2007: 12).

IPCC’s fourth report also provides examples of key technologies, policies and measures for mitigating climate change for the main sectors of energy supply, transport, buildings, industry, agriculture, forestry, and waste management (IPCC 2007: 17). It is critically noted that under energy supply the IPCC report also promotes nuclear power, a technology which is conflicting with issues of safety and sustainability and bears long-term health risks caused by radiation, uranium mining, potential nuclear power plant’s accidents, and used nuclear fuel rods storage. Under the sectors transport and agriculture biofuels produced from energy crops are promoted to replace fossil fuel use. It is critically noted that large-scale industrial biofuel production in developing countries can adversely impact local agriculture, food security, and biodiversity. Biofuel production could also cause disputes of land tenure between local farmers and exporting agro industries including issues of land grabbing and forced eviction of rural communities.

The national science academies of thirteen countries known as G8+5 comprising the Group of Eight (G8) plus the five economically largest emerging nations Brazil, China, India, Mexico, and South Africa, in the forefront of the thirty-third G8 summit held in

June 2007 in Heiligendamm, Germany, published a statement on growth and responsibility urging world leaders to “promote understanding of climate and energy issues and encourage necessary behavioural changes within our societies” (Joint science academies’ statement 2007: 2). Stating the reinforcement of previous conclusions of their earlier 2005 statement by scientific research undertaken since then, the science academies highlight the need to “cooperate in identifying common strategic objectives for sustainable, efficient and climate friendly energy systems” (Joint science academies’ statement 2007: 2).

The national science academies of the G8+5 countries continued to issue joint declarations on acknowledging scientific consensus on anthropogenic causes of climate change in the following years. In 2008 the academies stated that “anthropogenic warming is influencing many physical and biological systems” and promoted the need for a “transition to a low carbon society” (Joint science academies’ statement 2008: 1). In preparation of the UNFCCC negotiations in Copenhagen, Denmark, in December 2009 the academies stated that the “need for urgent action to address climate change is now indisputable” and identified climate change together with the production of sustainable energy as “crucial challenges for the future of humanity” (G8+5 Academies’ joint statement 2009: 1). They repeatedly urged political leaders to agree on a well-coordinated energy agenda to “lead the transition to an energy efficient and low carbon world economy, and foster innovation and research and development for both mitigation and adaptation technologies” as well as “to combat negative consequences of anthropogenic climate change” (G8+5 Academies’ joint statement 2009: 1) by reducing greenhouse gas emissions.

The publication ‘Climate change: Evidence & Causes’, launched by the Royal Society and the US National Academy of Sciences in 2014, outlines how climate is changing due to demonstrably rising concentrations of anthropogenic greenhouse gases in the atmosphere. In view of inevitable future climate change the document states, that “if emissions of greenhouse gases continue unabated, future changes will substantially exceed those that have occurred so far” (Royal Society; NAS 2014: 33).

The Intergovernmental Panel on Climate Change (IPCC) on 18 March 2015 launched the final version of its Fifth Assessment Report, the so-called synthesis report,

integrating the contributions of the three IPCC working groups compiled over the years 2013 and 2014 on the topics of the physical science basis of climate change (working group I); impacts, adaptation and vulnerability (working group II); and mitigation of climate change (working group III). “Written by over 800 scientists from 80 countries, and assessing over 30,000 scientific papers, the Fifth Assessment Report tells policymakers what the scientific community knows about the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation” (IPCC 2015a: 1).

As the latest comprehensive scientific compilation the IPCC Fifth Assessment Report “confirms that human influence on the climate system is clear and growing, with impacts observed across all continents and oceans. Many of the observed changes since the 1950s are unprecedented over decades to millennia” (IPCC 2015b: v). This evidently leads to the consequence “that the more human activities disrupt the climate, the greater the risks of severe, pervasive and irreversible impacts for people and ecosystems, and long-lasting changes in all components of the climate system” (IPCC 2015b: v). Focussing on the question how to manage increasing risks of climate change, specifically in terms of extreme weather events, IPCC states that “stabilizing temperature increase to below 2°C relative to pre-industrial levels will require an urgent and fundamental departure from business as usual. Moreover, the longer we wait to take action, the more it will cost and the greater the technological, economic, social and institutional challenges we will face” (IPCC 2015b: v).

Pre-industrial levels are commonly taken as baseline for limiting global warming to two degrees Celsius. However, there are no sufficiently reliable temperature records back to 1750, the pre-industrial time before the industrial revolution starting in the second half of the eighteenth century has led to the burning of fossil fuels as major cause of emitting carbon dioxide. Therefore, available temperature data from the nineteenth century are assumed to be indicative of pre-industrial times and “1850-1900 is chosen here as the most reliable reference period, which also corresponds to the period chosen by IPCC to represent a suitable earlier reference period” (Met Office 2015).

IPCC provides scientific consensus on climate change for the United Nations and other international organisations, governments, science institutions, media, and the

interested public. This consensus on the state of climate science has been reached by hundreds of international lead authors and members of the scientific community in climate relevant sciences. As the lead scientists of the assessment reports account for the quality of science, it can be assumed that the findings “follow core science rather than policy or advocacy trends” (Pelling 2011: 17).

While focussing on the screening of thousands of articles published in peer review science journals has furnished proof of the institution’s scientific credibility, it might have excluded some additional knowledge, as “much local evidence for climate change impacts and experience in adaptation, particularly in Africa, Asia and Latin America and the Caribbean, is gained by local actors and held by civil society actors or published nationally or regionally” (Pelling 2011: 18). It has been shown that IPCC is recognised “as the world's most reliable source of information on climate change” (Science 2001), yet, additional fruitful sources of indigenous knowledge, experiences and practises on adaptation might be harnessed through extended cooperation with local researchers and institutions.

3.4. Climate change denial

Despite conclusive evidence published in scientific literature and summarised in the IPCC reports enduring doubts about anthropogenic causes of climate change and the existing level of scientific consensus are launched in public and media, based on political and economic interests rather than environmental data. Regarding differently used terminology, scepticism is seen as integral part of the scientific discourse providing scientific evidence as well, while denial is understood as disregard of research results lacking objective consideration and own evidence-based rationale.

In the United States of America (USA), since the late 1980s, a counterforce to the forming up scientific community of climate researchers has emerged with the goal to doubt their scientific findings and to prevent climate friendly legislation. Several “companies and industry associations - representing petroleum, steel, autos and utilities, for instance - formed lobbying groups with names like the Global Climate Coalition and the Information Council on the Environment” (Newsweek 2007).

Analysing the overall strategy of denial it has been observed that “this well-coordinated, well-funded campaign by contrarian scientists, free-market think tanks and industry has created a paralyzing fog of doubt around climate change” (Newsweek 2007). Lobbying groups with financial support from industrial companies engaged scientists who “argued first that the world is not warming; measurements indicating otherwise are flawed, they said. Then they claimed that any warming is natural, not caused by human activities. Now they contend that the looming warming will be minuscule and harmless” (Newsweek 2007). The strategy of claiming that climate science is uncertain in its results and still in dispute influenced public opinion and policymakers especially in the USA since then.

For instance, a strong interrelation between oil industry and climate change denial has been reported about the firm ExxonMobil (Exxon before the merger with Mobil in 1999), one of the world's largest oil and gas companies, by InsideClimate News, a non-profit web-based news organisation rewarded with the 2013 Pulitzer Prize for national reporting. As early as in 1977 when climate change was not yet on top of the public agenda, company scientists reported to the management of Exxon stating that “carbon dioxide from the world's use of fossil fuels would warm the planet and could eventually endanger humanity” (Banerjee et al. 2015). Exxon launched its own internal scientific research programme focusing on carbon dioxide emissions from fossil fuels and their impacts on the environment to establish “the company's understanding of an environmental problem that posed an existential threat to the oil business” (Banerjee et al. 2015).

At the same time, an early US scientific analysis on climate change was the 1979 report ‘Carbon Dioxide and Climate: A Scientific Assessment’ by a study group, chaired by Charney, for the Climate Research Board of the National Research Council. The paper, often called the ‘Charney Report’, stated that “atmospheric concentrations of carbon dioxide are steadily increasing, and these changes are linked with man’s use of fossil fuels and exploitation of the land” (Charney et al. 1979: vii). The report estimates “the most probable global warming for a doubling of CO₂ to be near 3°C with a probable error of ±1.5°C” and that the “warming will be accompanied by shifts in the

geographical distributions of the various climatic elements such as temperature, rainfall, evaporation, and soil moisture” (Charney et al. 1979: 2).

A counter movement denying global warming since then tried to prevent attempts to develop environmental policies and legislation in the USA and internationally. Despite its own in-house research results, leading to many earlier scientific publications on climate change, the oil firm Exxon from the late 1980s onwards reportedly “worked instead at the forefront of climate denial” with the goal “to manufacture doubt about the reality of global warming its own scientists had once confirmed. It lobbied to block federal and international action to control greenhouse gas emissions. It helped to erect a vast edifice of misinformation that stands to this day” (Banerjee et al. 2015).

Goldenberg in her 2013 article published in The Guardian revealed that between 2002 and 2010 around 120 million US dollars have been spent to support around one hundred anti-climate groups and thinktanks to cast doubt about climate change science. The money donated by wealthy conservatives was channelled through the Donors Trust Fund and the Donors Capital Fund, two donor-advised funds, and was spent on “organisations working to discredit climate science or block climate action” (Goldenberg 2013), mobilising against efforts of lawmakers to take action on global warming.

The Guardian 2013 published another article stating that secret funding of climate denial also happens in the United Kingdom (UK) where “wealthy rightwing donors secretly finance a highly professional campaign against policies to reduce greenhouse gases” (Ward 2013). Reportedly the Global Warming Policy Foundation serves as main lobby group as “its primary purpose seems to be to campaign against policies to tackle climate change by reducing emissions of greenhouse gases” (Ward 2013). For this purpose the foundation is lobbying the UK government “to stop subsidies for alternatives to fossil fuels and to abandon the UK's emissions reductions targets” (Ward 2013).

Several assertions, also called “climate myths” (Skeptical Science 1), are repeatedly used to influence public opinion and legislature processes in the interest of political and industrial lobby groups, although they have been scientifically rectified. Among favourite climate assertions distributed by some scientists are that the sun is causing

global warming; that climate models are unreliable; that climate has changed before; that more carbon dioxide (CO₂) is good for plants; and that there is no scientific consensus on climate change (Skeptical Science 1).

Climate assertion 1: The sun is getting hotter and is causing global warming

The argument: “Over the past few hundred years, there has been a steady increase in the numbers of sunspots, at the time when the Earth has been getting warmer. The data suggests solar activity is influencing the global climate causing the world to get warmer” (Skeptical Science 2).

Indeed, solar activity has an influence on global climate. Studies analysed that over the past 1,150 years levels of global temperature were matching with levels of solar activity. However, an analysis of independent measurements of solar activity confirmed that after the year 1975 global temperatures were warming while the sun has shown a slight cooling trend, therefore contributing a slight cooling effect to the climate in recent decades. “Since the sun and climate are going in opposite directions scientists conclude the sun cannot be the cause of recent global warming” (Skeptical Science 2).

Climate assertion 2: Climate models are unreliable

The argument is that climate models “are full of fudge factors that are fitted to the existing climate, so the models more or less agree with the observed data” (Skeptical Science 3).

However, while complex models always can show some uncertainties they have been tested to reproduce historical trends (hindcasting) and have successfully predicted global land surface, air and ocean temperatures since the nineteenth century confirmed by observations and empirical evidence (Skeptical Science 3). IPCC in its 2001 report has used a climate model showing three simulated annual global mean surface temperatures. The first is based only on natural causes like solar variation and volcanic activity, the second on anthropogenic causes like greenhouse gases, and the third on both natural and anthropogenic causes. The comparison shows that temperature changes observed since the second half of the nineteenth century best match “when both natural and anthropogenic factors are included” (IPCC 2001: 11).

This testing of climate models against historical data of climate change suggests that models are unable to simulate global warming of the past decades without taking the rising emission of greenhouse gases into account. The concluding assumption is that if climate models can correctly show past trends they are expected to predict future trends with reasonable certainty. Additionally, models have improved since 2001 and “with increasing sources of real-world information such as satellites, the output of climate models can be constantly refined to increase their power and usefulness” (Skeptical Science 3).

Climate assertion 3: Climate has changed before

The argument: “Ice ages have occurred in a hundred thousand year cycle for the last 700 thousand years, and there have been previous periods that appear to have been warmer than the present despite CO₂ levels being lower than they are now. More recently, we have had the medieval warm period and the little ice age” (Skeptical Science 4).

Indeed, there have been periods of global warming before the dawn of mankind. Huge and rapid greenhouse gas emissions were caused by “often unusually massive volcanic eruptions known as ‘Large Igneous Provinces’, with knock-on effects that included huge releases of CO₂ and methane from organic-rich sediments” (Skeptical Science 4). About forty times larger than the largest present volcanoes the gigantic eruptions of those Large Igneous Provinces, the last one happened sixteen million years ago, rapidly generated huge quantities of greenhouse gases delivered into the stratosphere. These events caused abrupt global warming with rising sea levels and ocean acidification and finally were highly destructive to life provoking mass extinction of species. Nowadays climate change is causing similar symptoms by human caused greenhouse gases emissions (Skeptical Science 4).

Climate assertion 4: More carbon dioxide is good for plants

The argument is that carbon dioxide (CO₂) together with water is required for photosynthesis, hence being the ‘food’ that sustains plants on soil and in the sea. Higher absorption of CO₂ from the air or water will stimulate the growth of nearly all plants, as shown by experiments (Skeptical Science 5).

While it is possible to enhance growth of plants with additional CO₂ plus increased water and fertilizer use, and protection against insects, especially under controlled experimental conditions inside of greenhouses, the overall effects of an increase of CO₂ on plants and agriculture in general could be less favourable. First of all, CO₂ enhanced plants need more water for larger growth and greater moisture evaporation due to increasing temperatures, in times when climate change will increase water scarcity on the long run. Global warming caused by higher atmospheric CO₂ concentration also will lead to more aridity of land and growing desertification, reducing arable land; and more storms and heavy rainfalls will cause damage to plantations and wash off fertile soil. Additionally, too high concentrations of CO₂ in plants can reduce the nutritional value of staple foods, for instance wheat, and can increase their vulnerability to insects, as shown with the example of soybeans (Sceptical Science 5). In any case, some potential short term effects for enhanced growth of plants due to rising carbon emissions can be outbalanced by the overall long-term adverse impacts of climate change on agriculture and food security.

Climate assertion 5: There is no scientific consensus on climate change

As presented in the previous chapter on scientific consensus, anthropogenic global warming is recognised by about ninety-seven percent of climate scientists actively publishing scientific evidence on climate change, by science academies around the world, the Intergovernmental Panel on Climate Change (IPCC) and UN bodies like the United Nations Framework Convention on Climate Change (UNFCCC).

IPCC sometimes is accused of being alarmist in its finding and predictions and even “politically motivated to exaggerate the dangers of global warming and the level of human influence on climate change” (Skeptical Science 6). However, studies comparing most recent data to IPCC predictions show that IPCC is rather cautious in its conclusions compiled by several hundreds of international scientific lead authors and “that climate change is occurring more rapidly and intensely than indicated by IPCC predictions” (Skeptical Science 6).

On the topic of expert credibility, a 2010 study published by the US National Academy of Sciences analysed a dataset of 1,372 climate researchers with their publications and citation data. The study stated that “a vocal minority of researchers and other critics

contest the conclusions of the mainstream scientific assessment, frequently citing large numbers of scientists whom they believe support their claims” (Anderegg et al. 2010: 12107). This group “has received large amounts of media attention and wields significant influence in the societal debate about climate change impacts and policy” (Anderegg et al. 2010: 12107).

The authors “provide a large-scale quantitative assessment of the relative level of agreement, expertise, and prominence in the climate researcher community” (Anderegg et al. 2010: 12108) on anthropogenic climate change (ACC). The results of the study show that, ranked by the expertise of scientists regarding the number of climate publications, the group unconvinced by the evidence on climate change published in scientific literature, comprises two percent of the top fifty researchers, three percent of the top hundred, and 2.5 percent of the top 200 scientists (Anderegg et al. 2010: 12107).

The study concludes that “97 - 98% of the climate researchers most actively publishing in the field surveyed here support the tenets of ACC outlined by the Intergovernmental Panel on Climate Change”, and that “the relative climate expertise and scientific prominence of the researchers unconvinced of ACC are substantially below that of the convinced researchers” (Anderegg et al. 2010: 12107). The authors recommend “considering expert credibility in the relative weight of and attention to these groups of researchers in future discussions in media, policy, and public forums regarding anthropogenic climate change” (Anderegg et al. 2010: 12108).

Researchers need to support their findings with evidence and undergo peer-reviewed processes for publication. Consequently, a study analysed peer-reviewed climate science papers from 1991 to 2011 on the topics of global climate change and global warming. Published in Environmental Research Letters in 2013 the study scrutinised 11,944 papers written by 29,083 authors and published in 1,980 journals on their position on “anthropogenic global warming (AGW)” (Cook et al. 2013: 1). The paper found “that 66.4% of abstracts expressed no position on AGW, 32.6% endorsed AGW, 0.7% rejected AGW and 0.3% were uncertain about the cause of global warming. Among abstracts expressing a position on AGW, 97.1% endorsed the consensus position that humans are causing global warming” (Cook et al. 2013: 1).

Similarly, the Canadian internet blog DeSmogBlog in 2012 stated that “polls show that many members of the public believe that scientists substantially disagree about human-caused global warming” and argued that “if there is disagreement among scientists, based not on opinion but on hard evidence, it will be found in the peer-reviewed literature” (Powell 2012). The author searched for papers published between 1991 and 2012 and analysed 13,950 articles on global warming or global climate change. Out of this sample, twenty-four articles (0.17 percent) “clearly reject global warming or endorse a cause other than CO₂ emissions for observed warming” (Powell 2012).

On the topic of denial of human-caused global warming it has been disclosed that political and economic lobby groups backed by a diminutive number of scientists are working on the prevention or weakening of climate sensitive legislature. Similarly, occasional attention is attracted in media, public, and policy discussions spreading alleged profound disagreement among climate scientists. However, it has been pinpointed that there is distinct scientific consensus on human-caused global warming, while explicit rejections are negligible and obviously lack scientific demonstrable refutation.

Resuming the thematic introduction on climate change, among the multiple challenges arising from a changing climate, three spheres of social research and socio-political relevance shall be outlined separately, all of them being significant factors of influence for long-term development planning: climate change in conjunction with food insecurity, conflicts, and migration.

3.5. Climate change and food insecurity

According to the Food and Agriculture Organisation (FAO) food insecurity is defined as “a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution or inadequate use of food at the household level. Food insecurity, poor conditions of health and sanitation and inappropriate care and feeding

practices are the major causes of poor nutritional status. Food insecurity may be chronic, seasonal or transitory” (FAO 1).

Globally there are about 795 million people undernourished, which at least means a decline of 167 million people during the last decade (FAO et al. 2015: 3). This reduction “is more pronounced in developing regions, despite significant population growth. In recent years, progress has been hindered by slower and less inclusive economic growth as well as political instability in some developing regions, such as Central Africa and western Asia” (FAO et al. 2015: 3).

The 2015 report on food insecurity in the world, jointly prepared by the Food and Agriculture Organisation of the United Nations (FAO), the International Fund for Agricultural Development (IFAD), and the World Food Programme (WFP), considers climate change as one driver for prolonged situations of food crises: “Over the past 30 years, the typology of crises has gradually evolved from catastrophic, short-term, acute and highly visible events to more structural, longer-term and protracted situations resulting from a combination of multiple contributing factors, especially natural disasters and conflicts, with climate change, financial and price crises increasingly frequent among the exacerbating factors” (FAO et al. 2015: 38).

IPCC expects major future climate change effects on rural areas “through impacts on water availability and supply, food security, and agricultural incomes, including shifts in production areas of food and non-food crops across the world” (IPCC 2014: 19). Additionally, threats of natural disasters are observed to be exacerbated by a changing climate. “Climate change multiplies the risks of natural hazards, through altered rainfall and temperature patterns as well as increased frequency and intensity of extreme events such as drought and flooding” (FAO et al. 2015: 40). More frequent disasters will cause direct negative impacts on agriculture, livestock, and fisheries as main global sources of food production and means of livelihood for rural communities.

Especially in countries with a predominantly agricultural economy the inclusion of gender awareness into policies can shape more comprehensive and efficient strategies on food production, food security and self-sufficiency, as well as disaster risk management. This will facilitate to better recognise and support women’s contribution in family farming and smallholder agriculture, thus contributing to address gender

inequalities, as “many rural women continue to face gender-based constraints that limit their capacity to contribute to growth” (FAO et al. 2015: 31).

Combating food insecurity means aiming for achieving food security defined as “a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Based on this definition, four food security dimensions can be identified: food availability, economic and physical access to food, food utilization and stability over time” (FAO 1). For more detailed analyses of these four dimensions of food security FAO on its website publishes indicators based on available and comparable data to build a food security information system (FAO 2).

Climate change “affects food production directly through changes in agro-ecological conditions and indirectly by affecting growth and distribution of incomes, and thus demand for agricultural produce” (Schmidhuber; Tubiello 2007: 19703). A shift towards a moderate incline of the potential use of agrarian land in higher altitudes is estimated to face a much bigger decline of usable agricultural land in lower altitudes. Thus, a regional perspective will be important for detailed impact assessments. Rising temperatures also will facilitate the expansion of agricultural pests and their survival during warmer winter periods. Therefore “the main concern about climate change and food security is that changing climatic conditions can initiate a vicious circle where infectious disease causes or compounds hunger, which, in turn, makes the affected populations more susceptible to infectious disease” (Schmidhuber; Tubiello 2007: 19705).

High dependence on a rather small number of commercialised staple foods increases the risk of severe food shortage in cases of any large-scale crop failure. According to FAO only fifteen crops provide ninety percent of staple food for the world’s population. The three main crop plants are paddy, maize, and wheat, counting for sixty percent of the world's food energy intake and feeding more than four billion people (FAO 3).

Wild plants are essentially contributing to the diet of rural subsistence households. Wild relatives of cultivated food crops are even more important in the context of food security, as indigenous species provide sources of natural genetic variety. If one was to

be found to be resistant to a specific agricultural disease crossing it with the cultivated commodities could generate their resistance as well. Efforts are underway to collect and preserve a variety of seeds, especially wild relatives of main food crops. Seed banks keep dehydrated seeds frozen over time and are therefore able to distribute huge variety of seeds to improve the agricultural biodiversity and support food security. For example, the Millennium Seed Bank in the United Kingdom preserves 76,000 seed samples from over 36,000 edible plants, and is actively involved to support agricultural adaptation to climate change (The Economist 2015a: 55). Seed banks and scientists work to be prepared for agricultural rescue missions. In case one of the main food crops would be extensively affected by pest or disease “a single useful gene lurking in one wild relative could prevent calamity” (The Economist 2015a: 56).

The widespread promotion of crop-produced biofuels for cleaner energy production is a potentially impedimental fact on the path to achieve food security in the context of climate change. Sugarcane, sugar beet, corn and wheat plantations are designated for the production of bioethanol, the mainly used biofuel, while biodiesel is made from vegetable oils like soybean, rapeseed and palm oil. While liquid biofuels have reached 127.7 billion litres global production in 2014 (REN21 2015: 19) and contribute to carbon emission reduction by partly reducing fossil fuel use, environmental and social concerns have been raised about their impacts.

Large-scale use of agricultural land for energy crops leads to the problem that “food production may increasingly compete with bio-energy in coming decades” (Schmidhuber; Tubiello 2007: 19707). Similarly, IPCC has pointed out that, together with forestation, “bioenergy plantations can restore degraded land, manage water runoff, retain soil carbon and benefit rural economies, but could compete with food production and may be negative for biodiversity, if not properly designed” (IPCC 2007: 61). Increased production can cause more deforestation, conversion of natural landscape into arable land, loss of biodiversity, growing pressure on water sources thus increasing water scarcity, and soil erosion due to monocropping and use of chemical fertilisers. Industrial biofuel production on arable land also carries the risk of rising food prices, social exclusion of rural communities or of ignoring “customary

rights of indigenous peoples and can result in a conflict of interest between agricultural production for food and for mobility” (Röhr 2007: 4).

As the debate over the sustainability of these first-generation biofuels continues, second-generation biofuels are under research and testing, produced from non-food parts of crops or from non-food crops like the jatropha tree, which can be cultivated in marginal agricultural land as well as in hot and arid regions and has seeds rich in oil. While there are positive examples of producing jatropha oil in community based processing mills for domestic use in villages, however, the plant’s ability to survive on dry land does not correspond with an economically viable oil production at a large scale on degraded land, unless oil yields might be enhanced through plant breeding or genetic modification, or plantations again need more fertile land and irrigation (Luoma 2009).

According to UNFCCC, top priority for mitigation is the reduction of human caused greenhouse gas emissions “within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner” (UNFCCC 1992: 9). It is worth mentioning that the convention’s foundation document from 1992 is linking climate change to food security and sustainable economic development.

FAO as well states that “economic growth is necessary for sustaining progress in efforts to reduce poverty, hunger and malnutrition”, yet it needs to be planned as “inclusive growth – growth that provides opportunities for those with meagre assets, skills and opportunities” and therefore “improves the incomes and livelihoods of the poor” (FAO et al. 2015: 42). The focus on the rural population in developing countries is identified as “an important component of a strategy for promoting inclusive growth and improving food security and nutrition” (FAO et al. 2015: 42). Furthermore, studies have shown that “food insecurity and malnutrition is significantly higher in protracted crisis contexts resulting from conflict and natural disasters” (FAO et al. 2015: 42). Climate change impacts on food security and livelihoods “are expected to disproportionately affect the welfare of the poor in rural areas, such as female-headed households and those with limited access to land, modern agricultural inputs, infrastructure, and education” (IPCC 2014: 19). Therefore, supporting family farming

and smallholder agriculture in adapting to climate change will not only secure rural livelihoods but improve the economic performance of agriculture in developing countries.

Climate change has been identified as exacerbating factor for natural disasters, infectious diseases and agricultural pests, thus negatively impacting food security. Yet, this conjunction forms the challenge to a more comprehensive coordination and combination of political strategies for achieving more sustainable results in promoting food security and adaptation to climate change.

3.6. Climate change and conflicts

Reflecting the broad international consent on IPCC's work on providing compiled scientific information on climate change and recognising the cohesion of climate change to potential future global conflicts, the Nobel Peace Prize 2007 was awarded to the Intergovernmental Panel on Climate Change (IPCC), and jointly to former US vice president Al Gore, "for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change" (Nobel Peace Prize 2007). The Norwegian Nobel Prize Committee further underlined that "according to the IPCC, there is a real danger that the climate changes may also increase the danger of war and conflict, because they will place already scarce natural resources, not least drinking water, under greater pressure and put large population groups to flight from drought, flooding, and other extreme weather conditions" (Nobel Peace Prize 2007).

In the context of human security IPCC states that "climate change can indirectly increase risks of violent conflicts in the form of civil war and inter-group violence by amplifying well-documented drivers of these conflicts such as poverty and economic shocks" (IPCC 2014: 20). Considering potential conflicts climate change can also be directly related to questions of national security, as "the impacts of climate change on the critical infrastructure and territorial integrity of many states are expected to influence national security policies" (IPCC 2014: 20).

A working paper on security and climate change for the Tyndall Centre for Climate Change Research, a United Kingdom (UK) based transdisciplinary study centre of eight

UK universities and the Fudan University in Shanghai, China, puts security as a “discourse on vulnerability” which is “more socially constructed than objectively determined” (Barnett 2001: 2). In general, security refers to the protection of danger for vulnerable entities like “the nation (national security), basic needs (human security), income (financial security) and property (home security)” (Barnett 2001: 2).

The United Nations Development Programme (UNDP) in 1994 introduced a new concept of human security, linking it to people and development rather than territories and arms. The “human security approach broadens the scope of security analysis and policy from territorial security to the security of people” (UNDP 2013: 2). UNDP lists economic, health, personal, political, food, environmental and community aspects as “seven essential dimensions of human security” (UNDP 2013: 2). This human security perspective is promoted as a participatory approach which “requires understanding the particular threats experienced by particular groups of people, as well as the participation of those people in the analysis process” (UNDP 2013: 2).

National security usually serves as main political security issue, as “large scale violent conflict is the concern that receives the most attention from policymakers, and developing military capability to respond to possible violent conflicts consumes large amounts of public resources” (Barnett 2001: 3). As the end of the Cold War was approaching with the fall of the Berlin Wall in 1989, the process of rethinking security policies showed that “environmental change is increasingly being understood as a security issue” (Barnett 2001: 2). Though recognising that military responses will not be able to solve challenges caused by climate change, the focus was still “on the way environmental change may interact with the same national security concerns that dominated policy throughout the 20th century, in particular the way environmental change may trigger violent conflict” (Barnett 2001: 2).

Yet, environmental security concerns could also be “motivated by Northern theoretical and strategic interests rather than informed by solid empirical research” (Barnett 2001: 5) and “factors such as poverty and inequities between groups, the availability of weapons, ethnic tension, external indebtedness, institutional resilience, state legitimacy and its capacity and willingness to intervene, seem to matter as much if not more than environmental change” (Barnett 2001: 6).

But there are also claims that climate change will lead to a growing number of conflicts “caused either by growing competition for access to and distribution of resources, such as water and arable land, or by the rising number of natural disasters” (Röhr 2007: 3). On this topic Science in 2013 published the online article ‘Quantifying the Influence of Climate on Human Conflict’ with a synthesis of research literature on the influence of climate change on conflicts. The analysis indicates that “the magnitude of climate’s influence on modern conflict is both substantial and highly statistically significant” (Hsiang et al. 2013), especially by changes in precipitation and temperatures. The authors conclude that considering potentially higher rising average temperatures of two up to four degrees Celsius until the year 2050 together with significant changes in precipitation “amplified rates of human conflict could represent a large and critical social impact of anthropogenic climate change” (Hsiang et al. 2013).

A 2007 study in Political Geography assesses the conjunction of climate change and environmental degradation with armed conflict and identifies “some of the most important factors assumed to be strongly influenced by global warming: land degradation, freshwater availability, and population density and change” (Raleigh; Urdal 2007: 674). Using geographic information system (GIS) data in analysing spatial areas of 10,000 square kilometres (3,861 square miles) each instead of political units the authors built on the historic experience that environmental changes mostly can be confined to specific areas rather than countries as a whole. The paper suggests that “if soil degradation, freshwater scarcity and population pressure have influenced the risk of conflict in the past, we assume that this may also inform us about likely security implications of climate change” (Raleigh; Urdal 2007: 675).

Consequently, the economic and political context need to be considered in conjunction with climate change factors, as both will have strong influence on the ability of societies for climate change adaptation. Within the broad discussion on environmental and climate factors as potential security threats “there appears to be a consensus that economic, political and social factors determine how countries handle resource scarcity. Wealthy and democratic countries are likely to be more capable both to adapt to resource scarcity and to mitigate conflict” (Raleigh; Urdal 2007: 675).

It needs to be added that unfavourable economic and political conditions together with inefficient state institutions in developing countries could pose a bigger threat of climate vulnerability to their population. Enhanced possibilities of internal conflicts over arable land, water and energy resources could put severe pressure specifically on marginalised social groups with limited access to these resources.

Links between climate change and armed conflicts were researched in the 2007 publication 'A climate of conflict' indicating "that problems that will be induced or exacerbated by climate change will combine with other factors to create a high risk of armed conflict in 46 conflict-affected states" (Smith; Vivekananda 2007: 17). The identified countries range over four continents and all of them "are characterised by some combination of current or recent wars, poverty and inequality, and bad governance. The latter often involves corruption, arbitrary authority, poor systems of justice and weak institutions of government, causing deficiencies in economic regulation and basic services" (Smith; Vivekananda 2007: 17).

While analysing the climate-conflict nexus not only aspects of vulnerability but also of the agency of people have appeared to be of special concern. "An actor-oriented approach to social vulnerability" (Bohle 2007: 9) considers vulnerable groups more as agents of dynamical adaptation to changing risks than as sheer victims. Consequently, vulnerability is conceived "as embedded in social and environmental arenas, where human security, freedoms, and human rights are struggled for, negotiated, lost and won" (Bohle 2007: 9). In the context of conflicts it also means "to consider the actors who cause vulnerabilities. An actor-oriented view on vulnerability will thus have to regard both the winners and the losers in the arenas of social vulnerability" (Bohle 2007: 15).

Such actor-oriented approach can facilitate the analysis of all potential parties involved in climate change induced conflicts. Furthermore, identifying social actors, their capacities and participation in decision-making processes is of special interest within a social science perspective, as the "capacities of the vulnerable to successfully live with risk are often much more dependent on their position in social fields of recognition and power" (Bohle 2007: 23).

From a gender perspective it needs to be considered that women and men can suffer from conflicts in different ways, and that gender roles also determine differential perceptions, interpretations and available options. In general, women “are the ones who bear the responsibility for the survival of the family during and after conflicts. Their workload increases in crisis situations while their income opportunities simultaneously decrease” (Röhr 2007: 4). Limited mobility due to restrictive social norms, lack of access to information, natural and financial resources, and minor participation in decision-making processes weaken the capability of women to cope with conflicts and post conflict situations.

The 2001 on the initiative of Japan established Commission on Human Security (CHS) in its 2003 final report ‘Human Security Now’ distinguishes between two main research areas, one dealing “with human insecurities resulting from conflict and violence, and the other with the links between human security and development” (CHS 2003: 153). Analysing conflict potentials requires to focus on “individuals or communities facing extreme situations like displacement, discrimination and persecution” and thus to address “the special security needs of people and the protection of victims, refugees and internally displaced people” (CHS 2003: 153).

Also pointing at the agency of people CHS states that safeguarding human security “requires both shielding people from acute threats and empowering people to take charge of their own lives. Needed are integrated policies that focus on people’s survival, livelihood and dignity” (CHS 2003: iv). Linking the topic of conflicts to development planning CHS proposes to address “the interrelations between insecurity and the need to ensure that developmental activities proceed alongside conflict resolution” (CHS 2003: 153). Empowerment and participation in risk and conflict reduction planning, and thus strengthening the agency of people, will also show positive financial impacts, as the costs for crisis management can exceed the costs of timely crisis prevention. “Hence national and international mechanisms for crisis prevention and peace consolidation should clearly grow in importance against traditional security policy, especially in the sphere of developmental, environmental and foreign policy” (Boschert 2007: 3).

Promoting “a conflict-sensitive approach to respond to climate change in conflict-prone or conflict-affected contexts” Vivekananda in her 2011 paper published by the nongovernmental organisation International Alert focuses “on how climate change and development policymakers and practitioners can promote peace-positive climate change adaptation actions which can yield the double dividend of building resilience to climate change and conflict” (Vivekananda 2011: 6). Identifying water, land, energy, and food security as issues under threat by climate change Vivekananda states that “inappropriate governance and management of these issues lie at the root of violent conflict in many developing countries” (Vivekananda 2011: 6).

Besides technical assessments and planning of actions “carrying out an analysis of the conflict actors, causes, profile and dynamics in a given context can ensure that actions do not inadvertently increase the risk of violent conflict, but rather serve to reduce potential or existing conflict” (Vivekananda 2011: 16). Although the paper observes an “increasing understanding of the links between climate change and security at the policy level, there is an implementation gap in terms of this being translated into practice” (Vivekananda 2011: 15). Calling for more flexible and cross-sectoral institutional arrangements the study proposes that “more energy should be put into exploring institutional structures which can supersede existing siloed architecture to promote genuinely joined-up working” (Vivekananda 2011: 15).

The German Advisory Council on Global Change (WBGU) has analysed “four conflict constellations in which critical developments can be anticipated as a result of climate change and which may occur with similar characteristics in different regions of the world” (WBGU 2007: 2), namely degradation of freshwater resources, decline in food production, increase in storm and flood disasters, and migration. With regard to international conflict scenarios the council states that “climate change could well trigger national and international distributional conflicts” (WBGU 2007: 1).

It has to be considered that transboundary issues like available water resources for drinking water, agricultural irrigation, and hydropower plants, and the use of cross-border ecosystem services could have the potential to provoke conflicts between neighbouring states. But the option should not be ruled out that “conflicts of interest over shared resources may be a vehicle for increased cooperation” (Raleigh; Urdal

2007: 678). Considerations for conflict prevention show the necessity that “national and international water resource management needs to be adapted to the impacts of climate change in order to avoid water crises” (Boschert 2007: 3). In this context it is noted that support for planning and implementing regional transboundary river basin management systems with the inclusion of climate sensitive approaches could contribute to reduce risks of climate conflicts on water resources.

Focusing on potential cooperation Scheffran and Battaglini in their 2010 analysis of security risks of global warming conclude that “whether climate change favours conflict or cooperation critically depends on the perceptions and responses of the actors involved and on societal structures and institutions” (Scheffran; Battaglini 2010: 32). To strengthen much needed cooperation the authors recommend “to build coalitions among those with mutual interests” (Scheffran; Battaglini 2010: 36).

As sea level rise is already observed countries along coastlines and small island states are facing growing risks to territory and living space for their population. Due to the hitherto occurring global warming further sea level rise is inevitable, as the thermal expansion of oceans will continue for centuries, in turn causing additional ice sheet melting, even after atmospheric greenhouse gas concentrations would have been stabilised (IPCC 2007: 67).

To give one example, political tensions already have arisen between Australia, New Zealand, and several Pacific island states about the question on limiting temperature rise, as not all countries are supporting the goal of stabilising temperature increase to below two degrees Celsius relative to pre-industrial levels. The third annual meeting of the Pacific Island Development Forum, held in Fiji in September 2015, demanded to keep global average temperature rise not higher than 1.5 degrees Celsius, fearing the final disappearing of atoll states below rising seawater levels due to insufficient reduction of greenhouse gas emissions especially by the industrialised nations in the Pacific region (The Economist 2015b: 51).

This demand was already articulated six years earlier by the Pacific island state of Tuvalu, one of the world’s most vulnerable nations to rising sea levels, during the United Nations Climate Change Conference in Copenhagen, Denmark, in December 2009. Tuvalu called for legally binding climate commitments “that would require more

aggressive reductions in greenhouse gas emissions and a more ambitious climate target than is being considered. Specifically, Tuvalu asked to amend the UN climate treaty to cap the rise in temperatures at 1.5 degrees Celsius, instead of the proposed two degrees above pre-industrial levels” (Democracy Now! 2009).

The same goal is pursued by the Alliance of Small Island States (AOSIS), an intergovernmental organisation forming a group of forty-four small island and low-lying coastal states “that share similar development challenges and concerns about the environment, especially their vulnerability to the adverse effects of global climate change” (AOSIS 1). The group’s motto “1.5 To Stay Alive” signifies the risk of entire countries under threat of total inundation by rising sea levels, and highlights the “importance of the ‘below 1.5 degrees’ as a global goal to limit warming”, as already “with an average global temperature increase of under 1°C, small islands have experienced impacts including severe coastal erosion, saltwater intrusion, marine habitat degradation, and powerful tropical storms” (AOSIS 2015).

Claiming that their member states “are the most vulnerable to climate change impacts, with entire countries under threat of total inundation – even at 2°C of warming”, this group of nations firmly, but finally in vain, demanded the “inclusion of ‘below 1.5°C’ as a long-term temperature goal and benchmark for the level of global climate action” (AOSIS 2015) to be agreed upon at the past UNFCCC Conference of the Parties, COP 21, in Paris, France, in December 2015.

Representing about 700 million people in different world regions the Vulnerable Twenty Group (V20) consists of finance ministers from twenty countries highly vulnerable to climate change. At its inaugural meeting in Lima, Peru, on 8 October 2015 the ministerial group highlighted the goal “to concentrate attention on economic and financial responses to climate change through the dedicated cooperative efforts” of their countries and “to foster a significant increase in investment in climate resiliency and low emissions development” (V20 2015: 1). As climate change is seen as a threat to the very own existence of their countries, V20 strives to at least avoid its most devastating implications. The group of countries stipulates the goal to limit the level of global warming to not more than 1.5 degrees Celsius and claims in its

communiqué that “urgent and ambitious global climate action is now a fundamental human right” (V20 2015: 1).

Research results indicate that climate change could have multifaceted implications on human security, and, in conjunction with political, economic, environmental and social factors, significantly amplify risks of violent and armed conflicts.

3.7. Climate change and migration

Analysing potential security risks in the context of climate change Barnett has pointed out that “climate-induced conflicts are most likely as a result of migration” (Barnett 2001: 8). It is still undetermined to which extent climate and environmental changes might cause additional migration movements within and from developing countries. To gain a deeper understanding of potential impacts of climate change on enhancing migration movements will require “understanding the way it will interact with other factors, and the ways these factors may change, as climate change will have uneven impacts on even proximate social and ecological systems” (Barnett 2001: 8).

In developing countries so far mostly seasonal and temporal migration patterns prevail for seizing better economic opportunities. Rural livelihoods largely depend on agricultural production and animal husbandry. From a gender perspective, male migration from rural communities causes exacerbated problems for female household members through the process of an increasing feminisation of agriculture. Traditionally, women are primarily responsible for collecting water and fuelwood, fodder for livestock, and medicinal plants. Women cultivate home gardens, manage the households, and hold family care giving roles. Men as the main breadwinners on the other side, additionally to their common agricultural work tasks like irrigation and ploughing the fields, are compelled to supplemental income generation, often as day labourers.

Where male family members migrate for better labour opportunities women remain in the villages and are forced to take over agricultural responsibilities and workload traditionally performed by men. Lack of access to agricultural extension services often tailored to male farmers also can hinder women’s participation in trainings on practices of irrigation, and the use of manure and pesticides, or organic farming. On

the other side, gender related effects can be observed as well when women are taking over control of household resources, and the inflow of remittances from migrants can strengthen women's economic status creating new financial opportunities. The question remains whether these financial resources are utilised in need for daily life household expenditures, education costs for children, increased consumption, or even for climate change adaptation measures.

Nonetheless it has to be noted that on the development agenda often the misconception prevails that mostly men migrate, not women. Irrespective of significant differences between countries regarding predominant male or female migration, women migrating for employment are "accounting for about half of the total migrants worldwide" (ILO 2003: 2). Regardless of the equal proportion "there have been changes in patterns of migration – with more women migrating independently and as main income-earners instead of following male relatives" (Jolly; Reeves 2005: 6), also due to a growing market demand for female workers.

Women seeking employment in the urban informal sector or domestic work are "often motivated as much by the income opportunities as by discrimination against women in areas of origin" (IOM 2015: 84). Rural-urban migration can provide options for women "to escape traditional gender roles, gender-specific discrimination or gender-based violence" (IOM 2015: 128) while offering possibilities for income generation, increasing personal autonomy, and a better social status within their families upon return. On the other side, despite the significant role of remittances for the economy in the countries of origin, migration of both men and women "can also expose people to new vulnerabilities as the result of precarious legal status, abusive working conditions, social isolation and exclusion, and particular health risks and discrimination" (Jolly; Reeves 2005: 3).

Apart from labour migration, potentially enhanced by climate change impacts, governments and communities need to prepare for circular migration movements for times of severe climate events like natural disasters, when return to the settlements of origin will still be possible after the events are over. Temporary facilities and social services for the time of relocation and support mechanisms for the people after return

need to be in place. However, if livelihoods of local communities cannot be secured any longer, relocation might become permanent.

The German Advisory Council on Global Change (WBGU) states that especially in developing countries “the increase in drought, soil degradation and growing water scarcity in combination with high population growth, unstable institutions, poverty or a high level of dependency on agriculture means that there is a particularly significant risk of environmental migration occurring and increasing in scale“ (WBGU 2007: 3).

Identifying climate change as one driver for migration movements the International Organisation for Migration (IOM) in its 2015 World Migration Report states that further increasing “large scale migration to urban centres is inevitable due to the global realities of aging societies, slow and uneven economic growth among regions in a country and among nations, and environmental and climatic instability“ (IOM 2015: 3). Growing population in urban centres in turn “poses a great deal of pressure on infrastructure, the environment and the social fabric of the city“ (IOM 2015: 3).

Apart from rising sea levels and consequently the threat of ultimate migration for the population of small islands and low coastal regions, migration movements are likely to be enhanced by extreme climatic events, with possible negative impacts on soil fertility, water availability, agriculture and livestock, infrastructure of housing, energy supply and transport, and human safety. “Communities generally adapt and are generally resilient to extreme events. However, as climate becomes increasingly variable extreme events may become more frequent and more severe, and this may stretch the limits of adaptability and resilience, making migration an attractive, if not the only option“ (Barnett 2001: 8).

Specifically “in developing countries planning for enhanced internal migration and international immigration is required given that they are more vulnerable to the impacts of climate change and most existing migration is within and between developing countries“ (Barnett 2001: 8). In this context of migration or displacement movements it has to be considered that women and children often face higher risks of exploitation, sexual violence, and human trafficking.

IPCC in its 2014 Summary for Policymakers as part of the Fourth Assessment Report states that “climate change over the 21st century is projected to increase displacement of people” especially when “populations that lack the resources for planned migration experience higher exposure to extreme weather events, in both rural and urban areas, particularly in developing countries” (IPCC 2014: 20). This could lead to enhanced internal and external migration posing challenges on the capacity and resources of countries for planning collocated migration movements.

Foresighted policy planning will therefore also require the reshaping of immigration policies and budgets for countries which are likely to become goals for climate induced migration or will face large internal migration movements, with a gender-sensitive perspective incorporated. A challenge will be where and how to resettle larger numbers of climate migrants, be it caused by severe disasters or as a planned adaptation strategy, while at the same time, preventing internal social or economic conflicts. One crucial question in the context of resettlement is the required access to space and land, calling for land based policy planning.

Cooperating with UN agencies and governments the Swiss nongovernmental organisation (NGO) Displacement Solutions supports policy development on access to land for people displaced by climate change impacts. In a consultative process the NGO developed a “comprehensive normative framework, based on principles of international law, human rights obligations and good practice, within which the rights of climate displaced persons within States can be addressed” (Displacement Solutions 2013: 8). Assuming that “most displacement will likely occur within State borders” (Displacement Solutions 2013: 8) the planning for climate displacement within the countries concerned “includes climate displacement risk management; participation by and consent from affected individuals, households and communities regarding such preparation and planning; land identification, habitability and use; development of laws and policies for loss suffered and damage incurred in the context of climate displacement; and development and strengthening institutional frameworks to support and facilitate the provision of assistance and protection” (Displacement Solutions 2013: 9).

A participatory and security approach is also emphasised by Smith and Vivekananda in their 2007 conflict study stating that “if the pressures of climate change lead large numbers of people to leave their homes and migrate to urban slums, that also is a form of adaptation. But what people want and need are forms of adaptation that protect human security” (Smith; Vivekananda 2007: 31).

To draw legal conclusions it is noted that if people are displaced within their own countries due to negative impacts of climate change, they will be seen as internally displaced persons under the responsibility of their respective governments. If due to the same impacts people are crossing international state borders they will not be granted refugee status as per the 1951 Geneva Convention Relating to the Status of Refugees, which is “the key legal document in defining who is a refugee, their rights and the legal obligations of states” (UNHCR 1). Established after the Second World War the convention originally covered refugees within Europe before the year 1951 and was amended by the 1967 Protocol Relating to the Status of Refugees providing universal scope of application thereafter (UNHCR 2010: 2).

The United Nations High Commissioner for Refugees (UNHCR) is mandated to “protecting the rights and well-being of refugees all over the world” (UNHCR 2). As a matter of course, when the UN Refugee Agency was established in 1950 there was no discussion at that time that climate change could evolve into a serious trigger for flight. According to the 1951 UN Refugee Convention refugees are identified as people who have crossed international borders establishing a plausible fear of persecution based either on race, religion, nationality, political opinion, or social group (UNHCR 2010: 3). However, UNHCR’s mandate over time has been broadened working “to ensure that everybody has the right to seek asylum and find safe refuge, having fled violence, persecution, poverty, war or disaster at home” (UNHCR 2), hence, apart from refugees, covering also asylum-seekers, internally displaced, stateless people, and returnees (UNHCR 3).

A 2008 working paper of the Inter-Agency Standing Committee (IASC), a forum for coordination and strengthening of humanitarian assistance among the key UN and non-UN humanitarian organisations established in 1992, analyses “how existing international legal frameworks may apply to populations increasingly affected by the

effects of climate change events and environmental degradation” (IASC 2008: 1). The paper states that environmental and climate factors causing people to cross borders are no legal reasons to be granted refugee status and that the denominations of “environmental refugee” and “climate refugee” (IASC 2008: 4) therefore have no legal fundament in international refugee legislation. The IASC paper even recommends not to use refugee terms any longer in order to avoid legal confusion and agencies like the International Organisation for Migration (IOM) and UNHCR prefer using terms like ‘environmentally displaced persons’ instead. However, the terms ‘climate refugees’ or ‘climate change refugees’ are widely used in contemporary social research.

On these grounds, so called environmental or climate refugees are not reflected in international refugee laws and might be declared as illegal migrants, or at the most as internationally displaced persons since their cases are not covered by international refugee law. Hence the destination countries could deport these people back anytime, for instance when natural disasters are over.

There are proposals to update the UN Refugee Convention to include climate refugees, though it might be difficult to clearly identify environmental events caused by climate change as exclusive reason for migration. In this context concern has been raised by the UK Climate Change and Migration Coalition (UKCCMC), an alliance of refugee, human rights, development and environmental organisations with the goal “to challenge the lack of long-term strategies to support and protect people at risk of displacement linked to environmental change” (UKCCMC 1). UKCCMC states that there will be the “challenge of unpicking the root cause of the migration and distinguishing between slow-onset degradation and rapid climate disaster. If untangling climate change from the other causes of someone’s movement is difficult, then enforcing the updated convention could be impossible” (UKCCMC 2014: 9). In its analysing work on possibilities how to create legal protection for migrants in the cause of climate change the coalition is sceptical that “any attempt to expand the Refugee Convention could lead to a renegotiation resulting in the lowering of existing standards, which are themselves often interpreted in narrowest terms” (UKCCMC 2014: 9).

The coalition wants to support legal solutions to the problem that, “when people move in the context of environmental change, it is frequently the case that the law will fail to

protect their basic rights” and therefore “these people often slip between the gaps in existing legal protection” (UKCCMC 2014: 4). Different approaches are considered in the 2014 UKCCMC document be it on international level like “the addition of a protocol on climate induced migration to the United Nations Framework Convention on Climate Change (UNFCCC)” to foster discussions on policies and action plans, or to “fill the gaps in legal protection through regional instruments for migration linked to environmental change” (UKCCMC 2014: 11) by developing binding regional treaties. Priority still remains to first of all “preventing displacement through disaster risk and vulnerability reduction and other adaptation measures”(UKCCMC 2014: 14) before coming to agreements on temporary protection or permanent resettlement options.

A 2010 study in *Global Environmental Politics* raises the question how to build “systems of global governance that will cope with the global impacts of climate change“, and subsequently calls for “global adaptation governance” (Biermann; Boas 2010: 60). The study suggests the extension of the United Nations Framework Convention on Climate Change (UNFCCC) by a “Protocol on Recognition, Protection and Resettlement of Climate Refugees” (Biermann; Boas 2010: 76) to grant climate refugees a clear legal status outside the more exclusive UN Refugee Convention.

Also pointing at the difficulty of conceptualising terms like ‘climate refugees’ or ‘climate migrants’ the study uses the term ‘climate refugee’ in any case “since climate change will cause both transnational and internal flight” (Biermann; Boas 2010: 66). For both social research and policy development the authors propose to identify climate refugees “as people who have to leave their habitats, immediately or in the near future, because of sudden or gradual alterations in their natural environment related to at least one of three impacts of climate change: sea-level rise, extreme weather events, and drought and water scarcity” (Biermann; Boas 2010: 67).

Concluding the compilation of human causes, already occurring and possible future impacts of global climate change the need for intensified international cooperation seems obvious. As the German Advisory Council on Global Change (WBGU) has phrased it in 2007, “without resolute counteraction, climate change will overstretch many societies’ adaptive capacities within the coming decades” which could lead to

“destabilization and violence, jeopardizing national and international security to a new degree” (WBGU 2007:1).

However, the global menace of climate change “could also unite the international community, provided that it recognizes climate change as a threat to humankind and soon sets the course for the avoidance of dangerous anthropogenic climate change by adopting a dynamic and globally coordinated climate policy” (WBGU 2007:1).

3.8. Climate change mitigation

Mitigation means to “reduce the exposure to climate change, including its rate and extent” (IPCC 2007: 64). The aim of the United Nations Framework Convention on Climate Change (UNFCCC) is to achieve “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” (UNFCCC 1992: 9). IPCC has pointed out “that with current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades” (IPCC 2007: 44). Hence, prior-ranking for mitigation is an adequate reduction of human caused greenhouse gas (GHG) emissions comprising mainly carbon dioxide, as well as methane, nitrous oxide, and halocarbons. Stabilising emissions only would lead to further increasing atmospheric concentration levels as natural processes of removal require much longer time periods.

Mitigation is mainly understood as the process to reduce and minimise greenhouse gases through climate friendly policies and low carbon economies. The responses of countries to climate change depend on their political, economic, social and environmental circumstances and on available knowledge and technologies. This envisaged stabilisation of atmospheric concentrations has to happen “within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner” (UNFCCC 1992: 9). Mitigation measures towards low carbon economies also include further promotion of renewable energies and improving efficient energy use mainly in industry, buildings, urban planning, and

transportation. An important role as well plays the capacity enhancement of the natural storage of carbon dioxide, so called carbon sinks, mainly through reforestation.

From a perspective of social justice it needs to be considered “that the transition to a low-carbon growth path, at least in the near term, should be undertaken primarily by richer countries and in those sectors that account for the bulk of GHG emissions: energy, heavy industry, buildings, and transport systems” (Mearns; Norton 2010: 2). Developing countries themselves contribute to global greenhouse gas emissions mainly by agriculture and deforestation for changes of land use, therefore, “policy responses to mitigation in the agriculture and forest sector” (Mearns; Norton 2010: 3) are of high importance.

As mitigation discussions also raise questions of fairness there is the “need for an equitable sharing among nations of the responsibility for reducing GHG emissions, based on an acknowledgment of the highly unequal distribution of past, present, and projected future emissions among them” (Mearns; Norton 2010: 8). However, in developing countries, national agendas for social and economic development need to be considered while negotiating the process of transition to low carbon economies. It is beyond dispute that for the short term “access to affordable energy for the poor is a prerequisite for poverty reduction and economic growth” (Mearns; Norton 2010: 9).

Renewable energy in conjunction with improved energy efficiency increasingly is considered as important for mitigating climate change, supplying sustainable energy services, and providing jobs and economic opportunities. The Renewable Energy Policy Network for the 21st Century (REN21) reports that by 2014 end renewable energy technologies, mainly wind power, solar photovoltaic, and hydropower, supplied an estimated 22.8 percent of global electricity, while the majority part of 77.2 percent was generated by fossil fuel and nuclear power plants (REN21 2015: 18).

Still, more than one billion people, about fifteen percent of the global population, have no access to electricity, the majority in rural areas (REN21 2015: 12). To meet this energy demand and the associated development aspirations, electrification programmes are of high priority on national development agendas. Apart from connecting households to main power grids, renewable energy production has turned out to be specifically suitable for remote and mountain communities, be it as

individual household based systems or as decentralised small grid solutions. Besides solar systems and pico-hydro stations also new technologies have emerged like “pico-wind turbines for powering remote telecommunications; solar-powered irrigation kits; and digitisation of ancillary services and monitoring” (REN21 2015: 12), further leading to wider customer coverage and improved maintenance services.

It is widely observed that rural electrification yields multiple benefits for households in terms of labour easement, health improvement, education, and income generation, thus contributing to the overall socio-economic progress specifically in developing countries with additional positive impacts on natural resources and lower carbon emissions through reduced firewood consumption. With the renewable energy sector showing steady growth, in the year 2014 with new global investments of at least 301 billion US dollars in renewable power and fuels (REN21 2015: 11), private sector investments and public-private partnerships complement financing from development banks and financial institutions.

However, challenges remain to design policy frameworks for a further energy transition towards renewables and for more comprehensive energy efficiency to create stable political environments for investments, to reconsider state subsidies for fossil fuel and nuclear energy production and to improve power transmission systems to reliably integrate renewable power production from different sources.

In the context of climate change, it is also highly relevant to include climate risk assessments into planning and implementation of renewable energy systems. Hydropower plants, for example, can be exposed to altered river flows, seasonal floods or even glacial lake outburst floods (GLOFs). Early warning systems together with impact scenarios for upstream and downstream areas of river basins need to provide safety for the population.

Prevention of excessive and often illegal deforestation causing the release of carbon stored in trees will also contribute to mitigate carbon dioxide emissions. As reported by FAO, though global emissions from deforestation are decreasing, deforestation and forest degradation still account for around ten percent of global GHG emissions (FAO 4). Especially in developing countries mitigation options of reducing emissions from deforestation and forest degradation (REDD+), including conservation and

enhancement of forest carbon stocks and sustainable forest management, are high on UNFCCC's agenda (UNFCCC 2014).

Larger forest cover will foster carbon sequestration, the process of capturing and storing carbon dioxide from the atmosphere via photosynthesis of trees and other plants. While converting sunlight into energy, plants store carbon and release oxygen, a fundamental process of enabling life on earth. Additionally, sustainable forest management can preserve diversity and good condition of forests and provide controlled amounts of timber and non-timber products, thus sustaining healthy forests and benefitting the livelihood of rural communities while achieving long-term carbon sequestration. Oceans are natural carbon sinks as well, but increasing absorption of carbon leads to rising ocean acidification with incalculable ecological risks. There are also attempts to capture carbon waste from fossil fuel power plants and keep it deep underground at geological storage sites but uncertainty remains about long-term security and potential leakage risks.

The other side of the coin is that industrialised countries use the REDD+ mechanism to compensate for their own carbon emissions by financing these efforts of preserving forest carbon stocks in developing countries. Considering poverty and gender implications of this global policy it has been highlighted that such "commercialisation of previously free natural resources" may result in a "further exclusion of poor and landless people, often women, who depend on products from the forests for their livelihoods but rarely benefit from the economic incentives" (Skinner 2011: 3). Especially when legal land ownership is not secured, local communities traditionally involved in forest utilisation and protection might be excluded from these payments for environmental services or even expelled from their ancestral land.

Potential synergies between mitigation and adaptation can be achieved, requiring well-coordinated interactions between different sectors. IPCC provides some examples for synergies like improving energy efficiency and switching to cleaner energy sources, which would lead to reduced emissions and less health-damaging air pollution; reducing consumption of energy and water in urban areas through greening cities and recycling water; promoting sustainable agriculture and forestry; and protecting ecosystems for their important services and for carbon storage (IPCC 2014: 28).

In any case, delays in sufficiently reducing carbon emissions will jeopardise chances to stabilise carbon levels in the atmosphere to limit global warming below two degrees Celsius in relation to pre-industrial levels, and thus will significantly increase adverse climate change impacts.

4. Adaptation to climate change

“It is time to recognise that while mitigation is essential, its benefits will come slowly and, in the meantime, adaptation is urgent” (Smith; Vivekananda 2007: 25). IPCC has expressed its concern “that the ability of many ecosystems to adapt naturally will be exceeded this century” (IPCC 2007: 65). It is crucial to understand that adaptation to current climate change impacts cannot be used as excuse for less mitigation efforts. Long-term adaptation only can be achieved in a sustainable way if essential mitigation measures happen simultaneously. Otherwise adaptation measures soon might be jeopardised by more negative impacts of increasing global warming.

4.1. Definition of climate change adaptation

Climate change adaptation has the target to reduce the sensitivity to adverse climate change impacts. Hence, adaptation is understood as “adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change” (UNFCCC 1). In a nutshell, adaptation is considered as “the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities” (IPCC 2014: 5). Therefore, climate change adaptation broadly is considered a necessity in planning processes at global, regional and national level.

While mitigation is understood as the process to minimise greenhouse gases through climate friendly policies and low carbon economies, coping is considered as immediate action after incidents by changing practises with temporary solutions. Adaptation on the other hand aims at changing practises permanently and implementing relevant support systems. Besides the urgency of mitigation measures to reduce emission of

greenhouse gases the issue of adaptation to climate change requiring the creation of locally coordinated responses evolved as “part of the dominant climate policy discourse and policy making at all levels” (Román et al. 2012: 253).

Adaptation hereby is defined as the process of assessing ongoing climate changes and planning adaptive responses including required changes of current practices. At different sites all over the world positive results are achievable and have been achieved dealing with specific climate impacts like changing weather patterns. Due to the dynamic nature of climate change as long lasting global phenomenon adaptation needs to be understood as continuous and flexible process with political, social, cultural and economic implications.

4.2. Climate change adaptation as social field

In this thesis adaptation is recognised beyond technical expertise as a multilayer social field with a variety of social actors, interlinked with various spheres of activity like promotion of social and behavioural changes, communication and knowledge transfer, decentralised policy planning, social participation, and capacity building of formal and informal institutions, collectively aiming at promoting locally adapted solutions for the sustainable and climate resilient development of communities and societies.

At this juncture, the overall aim is to reduce exposure and vulnerability of communities to current climate change impacts while planning adaptation to potential future changes in a timely manner. IPCC states that “effective risk reduction and adaptation strategies consider the dynamics of vulnerability and exposure and their linkages with socioeconomic processes, sustainable development, and climate change” (IPCC 2014: 25).

Consequently, adaptation is regarded as “place- and context-specific, with no single approach for reducing risks appropriate across all settings” (IPCC 2014: 25). Well planned adaptation strategies also can reap benefits for development “while helping to improve human health, livelihoods, social and economic well-being, and environmental quality” (IPCC 2014: 25). To facilitate adaptation planning and implementation efforts at the local level, national governments can ensure efficient coordination and assistance “by protecting vulnerable groups, by supporting economic

diversification, and by providing information, policy and legal frameworks, and financial support” (IPCC 2014: 25). Additionally, local government and the private sector can play important roles for the upscaling of successful adaptation measures. In any case, in the occurrence of climate change impacts “issues of climate justice, compensation, and government responsibility for reducing vulnerabilities through adaptation are central to policy debates” (Nelson et al. 2007: 396).

The climate discourse emphasises the interrelation between planning of adequate adaptation measures and socio-cultural contexts. “If policies are to alter socio-technical systems they must influence the behaviour of individuals and organizations, that is, the actors within the system” (Román et al. 2012: 255). Participatory and gender-sensitive local planning processes together with clearly communicated information based on scientific climate research, and knowledge transfer to local governments and communities will go a long way towards designing climate friendly and context appropriate responses. Social participation in combination with political decentralisation of decision-making power also leads to more inclusive governance systems.

In particular, “traditional knowledge systems and practices, including indigenous peoples’ holistic view of community and environment, are a major resource for adapting to climate change” (IPCC 2014: 26). Well planned adaptation options therefore can contribute to the diversification of livelihood opportunities and resilience building of rural communities. Constraints and limitations of adaptation can occur if “the complexity of adaptation as a social process” (IPCC 2014: 28) is not fully recognised. Lack of social participation will lead to simplified views on achievable adaptation measures. Deficient planning and insufficient allocation of financial and human resources hinder effective adaptation implementation. Responding only to short term climate variability also bears the risk of causing maladaptation and increased vulnerability to long-term climate change impacts.

Politically, socially and economically marginalised people, both women and men, are affected by discrimination, poverty and oppression, and lack of resources and opportunities to secure their livelihoods, thus more prone to negative impacts of climate change. However, it has been observed that “the tendency within mainstream

gender analysis of climate change is to conceptualize women everywhere as a homogenous, subjugated group - 'the poorest of the poor' - irrespective of their location (rural or urban), their social classes or castes, their ages, their degrees of education or access to resources, their embeddedness in social networks, the numbers of dependents they support, and so forth. On the basis of this presumed universal vulnerability, the default has been to focus exclusively on women" (Demetriades; Esplen 2010: 139).

On the other side, while broad civil society movements are promoting women's rights in adaptation planning and implementation, realities of widespread women's suppression by political and socio-cultural power structures also call for social science's continuous and creative support for enabling policy development in order to "ensure that regressive cultural practices do not hinder women's capacity to adapt" (ActionAid 2007: 19). In any case, while aiming for gender equality, deeper context and gender specific analyses of living conditions, skills and capacities, and access to information, technologies and finance will generate a better understanding of gender disaggregated realities and facilitate to develop gender responsive and complementary adaptation strategies for both women and men together.

4.3. Adaptation and development

It needs to be considered that capacity for adaptation is strongly connected to social and economic development, but unevenly distributed across countries and also within societies (IPCC 2007: 56). There is high apprehension that negative climate change impacts "will hit developing countries particularly hard. Timely adaptation measures should therefore be an integral element of their national policies" (Boschert 2007: 3). Since the United Nations Framework Convention on Climate Change (UNFCCC) was established in 1992, and although the UNFCCC founding document has highlighted "the legitimate priority needs of developing countries for the achievement of sustained economic growth and the eradication of poverty" (UNFCCC 1992: 6), the international discourse often was characterised by contradictions between climate change mitigation and economic development aims, based on conflicting views of industrialised and developing countries. While industrialised nations argued for negotiating global commitments to reduce carbon emissions, developing countries

expressed the need for further socio-economic progress to achieve their development goals (Román et al. 2012: 251).

From the earlier focus on sole mitigation through negotiating carbon emission reductions the climate discourse has increasingly addressed adaptation and vulnerability as key areas (IPCC 2007: v). This shift was supported by climate research recognising that “additional adaptation measures will be required to reduce the adverse impacts of projected climate change and variability, regardless of the scale of mitigation undertaken over the next two to three decades” (IPCC 2007: 14).

Furthermore, there is widespread concurrence that “emissions reductions necessary to meet the challenges of global warming can only be achieved by major changes in socio-technical systems” (Román et al. 2012: 251). Nowadays, growing political awareness of the requirement to combine climate change mitigation, adaptation and socio-economic development agendas open new spheres of activity. The relevance of policy integration is prevailing, as the “discussion regarding development policies as a vehicle for concrete climate action is right at the centre of the current policy debate” (Román et al. 2012: 258). Indeed, synergies between climate and development agendas are achievable. Designing climate resilient development policies based on a better trade-off and interpenetration of the different strands of climate and development policy will go a long way to improve sustainable adaptation while avoiding the risk that divergent policies hamper each other’s goals.

Development policies can incorporate climate resilient pathways for socio-economic progress while broadening the perspective towards innovation of systems. For example, instead of improving single technologies to become more environmental-friendly, a broader approach for system innovations towards more sustainability includes planning and implementation of major changes in whole product supply chains from production to consumption (Smith et al. 2010: 439). As “sustainable development is increasingly understood in terms of ‘transitions’ to more sustainable socio-technical systems”, the technical elements need to be analysed together with social and cultural circumstances to better “understand these socio-technical interdependencies as a dynamic system” (Smith et al. 2010: 439). This system innovation approach can guide policy development and planning of transition

processes to lead to more sustainable and climate friendly systems in agriculture, energy, transport, accommodation, and communication. At the same time, improved systems and new technologies can trigger social changes and development.

Required adaptation planning appears “often imposed on societies and localities because of external undesirable change” (Nelson et al. 2007: 396). Besides the understanding of adaptation as reacting process to occurring impacts of climate change it also can be understood as a chance to actively seize new opportunities. For instance, despite limitations and constraints for rural women’s progress, research literature illustrates how “women in poor areas have started to adapt to a changing climate and can clearly articulate what they need to secure and sustain their livelihoods more effectively” (ActionAid 2007: 4). Changing cropping patterns or planting kitchen gardens, using renewable energy sources, starting small cottage industries, and safe shelters for protection of people and assets during erratic monsoon precipitation or floods are among the practical options. Yet, there is the need of capacity building on diversification of livelihood, governmental support, and access to information and finance, to enable rural women to put these options into broader practise.

General options for adaptation planning in the context of supporting sustainable livelihoods of rural communities mainly based on agricultural incomes can comprise short term planning options like introducing drought resistant local variety of crops and promoting alternative and off-farm options for income generation. Long-term planning options can include the transfer of knowledge and technologies to farmers, organic farming, water storage, all season gardening rather than shifting cultivation, tree cropping, marketing of non-timber forest products and change from collection to cultivation, and local value addition to raw products through processing based on product value chain assessments.

Furthermore, promotion of affordable mechanisation, extension of infrastructure for cold storage, processing and transportation, and support of communication technologies for market information will foster economic opportunities, while disaster risk reduction and the introduction of social protection systems will raise the adaptive capacity. The concept of mere protection of environment, especially forests, can be

further developed into applicable practices of sustainable management of natural resources. Economic benefits for local communities can be gained as well based on certified legal and sustainable production of timber and non-timber forest products.

Considering adaptation intrinsically linked to development will also include knowledge management and information sharing on practical responses to impacts of climate change on livelihoods and ecosystems at local, national and regional level, promoting networking at community and institutional levels.

To support least developed countries (LDCs) to develop national climate change mechanisms and to build capacity, UNFCCC in 2001 at the Conference of the Parties (COP 7) in Marrakesh, Morocco, established the so called National Adaptation Programmes of Action (NAPAs). Through these NAPAs, LDCs can identify their special adaptation needs and receive funding for projects. At the same time, the LDC expert group was established to provide technical support and advice on NAPAs (UNFCCC 1). From Bhutan, a representative of the National Environment Commission (NEC) is member of this group.

While these activities and projects of NAPAs and meetings of the expert group are ongoing, the need for more comprehensive adaptation planning beyond single projects was identified and led to the formulation of the Cancun Adaptation Framework in 2010 at the COP 16 in Cancun, Mexico (UNFCCC 1). Under this framework, the national adaptation plan (NAP) process was established to support adaptation planning specifically in least developed countries (LDCs). Developing this broader framework of “national adaptation planning can enable countries to assess their vulnerabilities, mainstream climate change risks, and address adaptation” (UNFCCC 2012: 5). These NAPs are meant to identify long-term adaptation needs through “a continuous, progressive and iterative process which follows a country-driven, gender-sensitive, participatory and fully transparent approach” (UNFCCC 2).

Especially in least developed countries like Bhutan risks of climate change are causing additional challenges to development. UNFCCC therefore supports the approach to develop adaptation planning within the context of planning sustainable development. Main objectives of the NAP process are to reduce vulnerability to the impacts of

climate change by building adaptive capacity and resilience and to facilitate the integration of climate change adaptation into development planning (UNFCCC 3).

Adaptation also can be linked to peacebuilding, especially in conflict or post-conflict areas. Both adaptation and peacebuilding can be pursued through dialogue and social participation, provided that adaptation is designed conflict-sensitive (Smith; Vivekananda 2007: 4). In this case, adaptation and peacebuilding can complement each other aiming for long-term socio-economic development (Smith; Vivekananda 2007: 8).

“Take urgent action to combat climate change and its impacts” (UN 2015: 14) has been formulated as goal number thirteen out of the seventeen sustainable development goals, adopted on 25 September 2015 by the United Nations General Assembly as the 2030 Agenda for Sustainable Development, to “balance the three dimensions of sustainable development: the economic, social and environmental” (UN 2015: 1). Among the specific targets for climate action the UN document emphasises that climate change measures need to be integrated into policies and planning at national level (UN 2015: 23).

4.4. Limits to adaptation

Despite extensive research and multiple practical possibilities it needs to be considered that adaptation to climate change cannot be seen as infinite process with permanent room for improvement. The scale or frequency of adverse climate change impacts might reach dimensions beyond social and economic adaptive capacities of households, communities, regions and countries. The occurrence of such intolerable risks beyond limits to adaptation necessarily will lead to a “discontinuity of behaviour in order to avoid the risk” (Dow et al. 2013: 305).

For instance, when agricultural livelihoods become threatened beyond feasible adaptation measures and no alternative off-farm income generation is locally available farmers will have to abandon their farms. If in case of such kind of compelled displacement migration occurs without advance planning it hardly can be called an adaptation strategy, but rather an inevitable survival necessity. If scenarios of reaching adaptation limits are not included in climate change risk assessments and policy

planning unintended migration movements of larger scale can magnify problematic social and economic situations within the affected countries. The possibility to reach limits to adaptation shows the “urgent need to identify and predict where limits are likely to occur in order to assess and prepare for the potential consequences” (Dow et al. 2013: 305).

4.5. Conceptualising adaptation

Summarising this analysis and review adaptation to climate change can be conceptualised as an integrated intellectual approach and course of action comprising (a) analyses of the nature of occurring and predicted changes and the vulnerabilities to these changes; (b) participatory and gender-sensitive decision-making processes to identify and plan appropriate, equitable and conflict-sensitive responses to reduce differentiated vulnerabilities and create beneficial opportunities for the diversification of livelihoods, building on the agency of social actors; (c) exchange of adequate scientific information, technological knowledge, and socio-cultural best practises, and strengthening of inclusive governance systems; (d) and implementation and subsequent evaluation of adaptation measures, in consideration of existing mitigation agreements, and in accordance with socio-economic development and disaster risk reduction strategies; (e) embedded in the overall goal to enhance the climate resilience of communities, societal systems, and economy, and the sustainability of agricultural and ecological systems; (f) while assessing potential adaptation limits and consequences.

4.6. Resilience of systems

In IPCC’s terminology resilience is defined as the “ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change” (IPCC 2007: 86). Resilience of social systems facing external threat is considered a concept exceeding the one of adaptation also due to its approaches to “promote stronger and accountable governance and more responsive and effective service delivery mechanisms” (Vivekananda 2011: 15). Consequently, conceptualising resilience as system-oriented approach broadens the understanding of adaptation

beyond mainly technical responses to climate risks (Nelson et al. 2007: 396). In this case resilience is defined as “the amount of change a system can undergo and still retain the same function and structure while maintaining options to develop” (Nelson et al. 2007: 396).

As resilience is understood to promote adaptive changes in order to secure the continuity of functions and systems in the face of adverse impacts of climate change, this mainly will be achieved through organisational and technological improvements. The resilience of socio-economic systems can be increased by “social protection, improved agricultural market governance and value chain development, as well as insurance programmes and effective early warning systems” (FAO et al. 2015: 40). Resilience building of social systems always needs to equally consider the resilience of ecological systems, both being intrinsically intertwined, as ecosystem services provide essential supplies for communities like food, freshwater sources, and natural medicines and offer space for cultural practises. Sustainable land management is considered as one approach to enhance the resilience of agricultural and ecological systems. In any case, building resilience “is specific to local conditions and thus capacity to identify and implement strategies at local level is key” (FAO et al. 2015: 40). However, by this definition resilience is “not questioning underlying assumptions or power asymmetries in society” (Pelling 2011: 78). Thus, resilience aiming for functional continuance of social systems also bears the risk of perpetuating conditions of social inequality within these systems. Some criticism on these precarious intrinsic aspects of resilience to potentially inhibit more fundamental systemic changes has been formulated noting that resilience offers “attractiveness as a solution to climate change risks for donors and government precisely because it does not challenge the wider status quo” (Pelling 2011: 80). Hence, support for resilience building can more easily generate short term implementation results in compliance with ruling governments and ensure adequate donor visibility as well.

4.7. Transition and transformation of systems

Searching for potentials of deeper changes of social systems in the context of adaptation this strand of theory distinguishes between transition and transformation

as additional layers of interaction between adaptation and development, constituting a resilience - transition - transformation framework (Pelling 2011: 81). Transition is conceptualised as “focusing on the governance regime but through acts that seek to assert full rights and responsibilities rather than make changes in the regime” (Pelling 2011: 78).

Reaching beyond the goal of functional continuance and rising to the challenge to overcome conditions of inequality inherent to social systems by promoting equality and securing rights, adaptation framed as transition has the potential to jolt some gradual political, economic, and socio-cultural changes. Yet, this potential of transitional change within established political and governance systems always can face the renitency of ruling elites or influential power structures benefitting from a certain status quo.

Finally, transformation is understood as “the deepest form of adaptation indicated by reform in over-arching political-economy regimes” (Pelling 2011: 78). Transformational adaptation can, for instance, take place in social organisations or in renewable resources management systems, wherever “profound change alters the distribution of rights and responsibilities and visions of development across society” (Pelling 2011: 108). Transformation is defined as “a fundamental alteration of the nature of a system once the current ecological, social, or economic conditions become untenable or are undesirable” (Nelson et al. 2007: 397). Yet, it has to be considered that undesirable and often untenable living conditions already exist for millions of poor and marginalised people without offering them new options and agency for system transformation. Consequently, transformation on deeper scales needs to overcome resilience and renitency within the respective power architecture of systems in order to initiate “a process that creates a fundamentally new social-ecological system” (Nelson et al. 2007: 400).

System transformation can provide scope for changing social contracts which lay down “the prevailing balance of rights and responsibilities in society and may be held in place by legitimate government or the rule of force. The social contract is determined by the balance of power in society” (Pelling 2011: 238). By critically reflecting established power structures transformational adaptation therefore will include

governance as modifiable area and will require backup by social learning processes aiming at the development of changes in values and practices throughout societies.

Building on this broad concept of adaptation it has been illustrated that the adaptive capacity of communities and societies and the decisions for adaptive measures need to be understood as “a social, cultural and political as well as a technical or economic judgement” (Pelling 2011: 226). Going a step further climate change also can be considered not only as an external threat and thus a driver of change, but even internalised in human societies as “both a product and driver of development” (Pelling 2011: 227). To meet the challenge on how to conceptualise climate change adaptation different layers and scales of adaptation efforts ranging from resilience over transition to transformation are possible. Looking at the root causes anthropogenic climate change appears to be “an expression of deeper and often harder to grasp socio-ecological relationships” (Pelling 2011: 243).

Nonetheless, it needs to be considered that predications of scale and magnitude of adverse climate change impacts always can remain somehow fuzzy. Hence, adaptation approaches at all levels, while intending to proactively anticipate future climate impacts, need to adhere to sufficient flexibility in their current and future responses.

4.8. Review of the UNFCCC Climate Change Conference 2015

In the field of international politics on climate change mitigation and adaptation, the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP 21) held from 30 November to 11 December 2015 in Paris, France, reconfirmed the conclusion that climate change “represents an urgent and potentially irreversible threat to human societies and the planet” (UNFCCC 2015a: 1) requiring well coordinated international action. Linking the topic to the common scientific consensus on climate change COP 21 reiterated that effective international response needs to be based on “the best available scientific knowledge” (UNFCCC 2015a: 21).

At the end of 2015, the year in which global mean warming reached one degree Celsius (°C) above pre-industrial levels for the first time since the industrial revolution (Met Office 2015), the Paris Climate Change Conference adopted the so called Paris Agreement, constituting a binding international accord on climate change. With the

Paris Agreement, 195 nations present at the conference decided to keep global warming “well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change” (UNFCCC 2015a: 22). A more flexible climate diplomacy accepting that industrialised countries will decide on their own contributions instead of negotiating fixed reduction rates of emissions seems to have facilitated this agreement.

Despite growing awareness about the need for stricter limiting of global warming, reflected in the urgent requests of several developing countries and groups like the Alliance of Small Island States (AOSIS) and the Vulnerable Twenty Group (V20) to set the limit at 1.5 °C, it is noted that this goal could not be achieved. The goal of 1.5 °C only is included in the Paris Agreement as desirable aim for additional efforts in mitigation. Even the UNFCCC press release right after the adoption of the document stated that a “1.5 degree Celsius limit is a significantly safer defense line against the worst impacts of a changing climate” (UNFCCC 2015b). At least, the Paris conference invited the Intergovernmental Panel on Climate Change (IPCC) to provide a scientific report by 2018 on emission pathways and impacts of a temperature increase below 1.5 °C (UNFCCC 2015a: 4).

However, the prior to the Paris conference communicated planned contributions of several industrial nations to reduce their greenhouse gas emission levels have raised substantial concern that global warming will exceed the agreed goal of two degrees Celsius. The conference stated that the planned mitigation contributions reported at that time would result in a projected level of fifty-five gigatonnes of emissions by the year 2030, while a reduction to forty gigatonnes would be required to keep the average global temperature increase below two degrees Celsius (UNFCCC 2015a: 3).

As the whole agreement is based on voluntary instead of binding emission reductions by nations, obviously much greater efforts to reduce emissions are inevitable to achieve the envisaged goal. In this context COP 21 reiterated that greater efforts in mitigation will also help to limit the need for even bigger adaptation actions (UNFCCC 2015a: 25). Hence, member states are encouraged to increase their intended contributions, and “the social, economic and environmental value of voluntary

mitigation actions and their co-benefits for adaptation, health and sustainable development” (UNFCCC 2015a: 15) will be acknowledged.

It is critically noted that, though the agreement itself is meant to be globally binding, no kind of enforcing measures let alone sanctions are provided to be imposed on member countries in case they do not adhere to their own decisions or commitments. In lieu thereof a facilitative expert committee for implementation was established under the agreement and shall work in a “non-adversarial and non-punitive” (UNFCCC 2015a: 29) manner.

To avoid that the Paris Agreement eventually might remain ineffective several systematic steps have been introduced. In the first half of 2016 all determined contributions of nations need to be registered and published online, which facilitates public monitoring and thematic discussion within or between countries. In 2018 a collective global stocktaking of the progress to achieve the two degree Celsius goal is planned. All countries are further requested to report their updated climate change activities in 2020 and then regularly every five years, and methodological consistency in data and baselines as well as clear reporting on both anthropogenic emissions by national sources and removals by sinks shall be ensured (UNFCCC 2015a: 4-6).

The Paris Agreement recognises the need to address loss and damage caused by adverse impacts of climate change (UNFCCC 2015a: 26). Yet, any legal possibilities for developing countries to request compensation for loss and damage due to greenhouse gas emissions by other nations are not incorporated, as a legal basis for liability or compensation is not provided under the agreement (UNFCCC 2015a: 8). Furthermore, under the topic of loss and damage, potential displacement or migration of people due to climate change impacts is not included.

On the other side, the need to support developing countries has been agreed. Enhanced technology development and special efforts on capacity building for developing countries have been decided (UNFCCC 2015a: 9-10). Financial support for mitigation and adaptation planning and activities shall be provided by institutions like the Green Climate Fund and the Global Environment Facility (GEF), as well as the UNFCCC’s Least Developed Countries Fund and Special Climate Change Fund, both administered by GEF (UNFCCC 2015a: 8). Finally, the developed nations are strongly

urged to significantly increase their financial support to developing countries with “the goal of jointly providing USD 100 billion annually by 2020 for mitigation and adaptation” (UNFCCC 2015a: 16).

Furthermore, the Paris Agreement promotes global access to sustainable energy in developing countries focusing on renewable energy (UNFCCC 2015a: 2). But it is critically noted that the further extraction of fossil fuels, including adverse environmental and human effects of fossil fuel production, is no topic of the climate agreement. This fact implicates that, along with emissions reduction, limitation of fossil fuel production as another main pillar of global climate change mitigation could not be agreed upon in the political climate agenda.

Also the issue of fossil fuel subsidies for artificially lower domestic prices of oil, gas, and coal could not be included into the mitigation efforts of the agreement. Only during the opening programme of the climate conference a communiqué was presented by the Friends of Fossil Fuel Subsidy Reform, a group of states and businesses, calling for the elimination of subsidies for fossil fuels considered to “encourage wasteful consumption, disadvantage renewable energy, and depress investment in energy efficiency” (FFFSR 2015). The communiqué further states that subsidy reform would free up additional funds for development, while protective measures for the poor against higher energy prices would be required. Overall, the Paris Agreement does not seem to provide a strong impetus for transformation of mainly fossil fuel based economies towards renewable energy based low carbon economies.

Anyhow, it is positively noted that some key topics of different strands of social research on the interlinkages of climate change with anthropology are mentioned in the Paris Agreement document, thus officially acknowledged by UNFCCC member countries. In view of the general link of climate change adaptation and development the Paris Agreement underlines the intrinsic relationship of climate change actions “with equitable access to sustainable development and eradication of poverty” (UNFCCC 2015a: 21) and intends “to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty” (UNFCCC 2015a: 22). The document recognises adaptation as a global

challenge key for the protection of people, livelihoods, and ecosystems particularly in developing countries vulnerable to climate change, while contributing to sustainable development (UNFCCC 2015a: 25). And with a rare link to a cultural context “the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity, recognized by some cultures as Mother Earth” (UNFCCC 2015a: 21) is mentioned.

Also in the context of climate change and development, the Paris conference noted the lack of financial and human resources in some least developed countries to formulate and implement a national adaptation plan (NAP) to integrate climate change adaptation into national development planning. To facilitate this process the conference members requested the Green Climate Fund to actively support the formulation of national adaptation plans (UNFCCC 2015a: 7).

In a broad summary, the political leaders at COP 21 acknowledged “that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems, with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate” (UNFCCC 2015a: 25).

With this approach for adaptation, the relevance of local contextualisation of climate change responses and of social participation in planning and implementation is recognised. The request for transparency could be interpreted as availability of relevant climate information at all levels, and transparent decision-making processes as well. This part also can be thematically linked to the affirmation of the important role of “education, training, public awareness, public participation, public access to information and cooperation at all levels” (UNFCCC 2015a: 21). Though the term ‘as appropriate’ gives some leeway to decision makers, traditional knowledge of communities should be brought into interaction with climate science to enhance chances of developing more socio-cultural appropriate holistic adaptation responses. Transdisciplinary cooperation of climate scientists and development planners is encouraged to work towards climate adaptive sustainable development policies, given

the fact that, as noted earlier, the capacity for adaptation is connected to socio-economic development, but unevenly distributed across countries and within societies (IPCC 2007: 56).

Regarding gender, apart from the general statement that adaptation should also follow a gender-responsive approach (UNFCCC 2015a: 25), the topic is mentioned only three more times in the Paris document. Gender equality, besides empowerment of women, is listed in the summary paragraph of the preamble, along with human rights, to be considered by countries when addressing climate change (UNFCCC 2015a: 21); capacity building for developing countries should as well be a gender-responsive process (UNFCCC 2015a: 28); and finally, in reference to the procedural decisions of the Paris conference, the goal of gender balance has to be taken into account for the establishment of the facilitative expert committee for implementation (UNFCCC 2015a: 14).

Yet, the climate agreement provides no reference to underlying structures of gender inequalities. As noted earlier, existing gender inequalities already cause higher rates of poverty among women throughout the world (Demetriades; Esplen 2010: 133), thus fortifying vulnerabilities to climate change as well. To achieve gender equality, gender specific analyses of living conditions, skills and capacities, and access to information, technologies and finance are required to better understand gender disaggregated realities and to develop gender responsive adaptation strategies for both women and men together.

On the nexus of climate change and food insecurity the Paris document recognises “the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change” (UNFCCC 2015a: 21). As noted earlier, negative impacts of climate change on food security disproportionately affect poor rural communities (IPCC 2014: 19) and support for family farming and smallholder agriculture in adapting to climate change is required. Countries in their efforts to reduce greenhouse gas emissions and strengthen resilience also should ensure not to endanger food production (UNFCCC 2015a: 22). Though no more details are mentioned, this could be interpreted as a reference to the earlier stated risks that large-scale use of agricultural land for energy crops to produce

biofuels can cause severe environmental and social problems and compete with local food production (Schmidhuber; Tubiello 2007: 19707; IPCC 2007: 61; Röhr 2007: 4).

On the topic of climate justice, firstly, the agreement takes note of its existence with the remark that climate justice is important for some in addressing climate change (UNFCCC 2015a: 21). Secondly, as the whole agreement is based on the “principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances” (UNFCCC 2015a: 22), the relationship between developed and developing countries includes some aspects of climate justice. While of course all countries should contribute “to reach global peaking of greenhouse gas emissions as soon as possible”, the developed countries “should continue taking the lead by undertaking economy-wide absolute emission reduction targets” (UNFCCC 2015a: 22).

From a perspective of social justice, in this global process of mitigation the disadvantaged position of developing countries is taken into consideration and the Paris Agreement recognises “that peaking will take longer for developing country Parties” (UNFCCC 2015a: 22). Moreover, the document points out as a kind of guideline “to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty” (UNFCCC 2015a: 22). At the same time, the special needs of least developed countries for funding and technology transfer should be taken into account (UNFCCC 2015a: 21). In this context, climate change actions also should consider “intergenerational equity” (UNFCCC 2015a: 21), another aspect of climate justice.

Specifically on human rights, a paragraph is included in the agreement’s preamble only, indicating that a closer conjunction of climate change and human rights could not be politically agreed upon at COP 21. More as a non-committal recommendation nations “should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights, the right to health, the rights of indigenous peoples, local communities, migrants, children, persons with disabilities

and people in vulnerable situations and the right to development” (UNFCCC 2015a: 21).

It may be recalled that the Human Rights Council (HRC) already in 2008 expressed concerns that climate change “has implications for the full enjoyment of human rights” (HRC 2008: 1). As noted earlier, HRC, while highlighting the importance of environment for sustainable development, particularly for housing and access to water, pointed at the link of environment protection in the context of climate change and the enjoyment of human rights (HRC 2008: 2). Thus, scope for deeper research and discussions on the interlinkages between climate change and human rights is noted.

The cohesion of climate change and economic systems is reflected in the role that sustainable ways of consumption and production play for climate change responses (UNFCCC 2015a: 21) and in the inclusion of resilience building of socio-economic and ecological systems into adaptation planning through economic diversification and sustainable management of natural resources (UNFCCC 2015a: 25).

As the final text version of the Paris Agreement had to be approved by political leaders, it hardly can be expected to include a critical reflection of underlying power structures. Thus, there is scope for further anthropological contributions beyond the Paris Agreement to examine “the role of power and inequalities in the effects of and responses to climate change” (Peterson; Broad 2009: 75), to analyse established power structures, and to explore transformational adaptation options on a deeper scale.

The signing ceremony of the Paris Agreement on Climate Change took place on 22 April 2016 at the UN headquarters in New York with 175 countries participating, among them Bhutan (Kuensel 2016a). The Paris Agreement entered into force on 4 November 2016 after the threshold was achieved on 5 October 2016 with at least fifty-five member countries together accounting for at least fifty-five percent of the global greenhouse gas emissions having ratified the document (UN 2016).

5. Regional perspective: The Himalayas

5.1. Topography

The Sanskrit word Himalaya means 'abode of snow', from 'hima' for snow and 'alaya' for abode (Oxford Dictionaries 1). The Himalayas form a mountain system in South Asia dividing the Tibetan Plateau from the plains of the Indian subcontinent, extending from west to east from mountain Nanga Parbat with 8,126 metres (26,660 feet) height in the Pakistani-administered part of Kashmir to Namcha Barwa with 7,756 metres (25,446 feet) in the eastern part of the Tibet Autonomous Region of China. Consisting of four parallel mountain ranges the Himalayas stretch for about 2,500 kilometres (1,550 miles) mainly through India, Nepal, and Bhutan, with Pakistan and China also occupying some parts (Britannica 1). Hence, in this study, Bhutan, China, India, Nepal, and Pakistan are considered as the five Himalayan regional countries.

The Great Himalaya Range as the central part is the world's highest mountain range, with ten of the thirteen highest summits exceeding 8,000 metres (26,247 feet) including Mount Everest (Tibetan: Chomolungma; Nepali: Sagarmatha), the world's highest summit with 8,850 metres (29,035 feet). The total area of the Himalayas amounts to about 595,000 square kilometres (230,000 square miles). Over the past fifty million years, the Himalayas have been uplifted through the collision of the Indian with the Eurasian tectonic plate, with accelerated speed some twenty million years ago. Within the past 600,000 years, the Himalayas became the world's highest mountains (Britannica 1).

Due to the continuous movement of the Indian tectonic plate beneath the Eurasian plate further uplifting of the Himalayan mountain range takes place and enormous stresses build up along the subduction zones. Hence, the Himalayan region is highly seismic active and extremely prone to major earthquakes. Among recent seismic events, a major earthquake with a magnitude (M) 7.8 shattered central Nepal in the morning hours of 25 April 2015, followed within one hour by two heavy aftershocks of M 6.1 and M 6.6. Next day, 26 April, another major aftershock with M 6.7 occurred. Just sixteen days later on 12 May an even stronger tremor with M 7.3 happened,

followed after half an hour by one with M 6.3 (USGS 1), a devastating series of earthquakes in this Himalayan country.

The continuous thrust faulting between the subducting Indian plate and the overriding Eurasian plate also resulted in earlier major earthquakes in the Himalayan region, for instance the M 7.6 tremor in the Pakistani-administered part of Kashmir on 8 October 2005. This disaster even led to some relief cooperation and the temporary opening of five crossing points along the disputed border line between India and Pakistan in the contested Kashmir region (ReliefWeb 2005).

Irrespective of climate change adding new challenges, the extremely high seismicity in the Himalayan region is a permanent risk for lives and livelihoods of people. Enhanced disaster risk management systems need to be implemented all over the region, including emergency response plans regarding shelter, water and food supply, health and sanitation, security and communication, fuel stock, and technical equipment for rescue and road clearing to remote villages, as well as adequate disaster response budgeting and effective fund distribution plans. Improved earthquake-resistant construction methods need to become mandatory, including financial support schemes for low-income households, and already existing regulations need to be enforced within the construction industry.

Besides the Antarctica continent and the Arctic polar region, the third largest deposit of fresh water in form of snow and ice is found in the Himalayas, sometimes called the 'third pole' or the 'water towers of Asia'. The Himalayan range has a total snow and ice cover of about 35,110 square kilometres (13,556 square miles) (ICIMOD 1). Thus, the Himalayas form an important part of the planet's cryosphere. Geographical places where, due to low temperatures, water only exists in its solid form as snow and ice like glaciers and ice shelves, and within permanently frozen ground called permafrost belong to the cryosphere. Formed by the entirety of the frozen areas around the world the cryosphere plays a role for the world's climate, and in some places, is habitat to people, plants, and animals (NSIDC 1).

Northwestward from the Himalayas the Karakoram range with the second highest peak in the world, K2 with 8,611 metres (28,251 feet), extends over about 500 kilometres (310 miles) through parts of China, India, and Pakistan, and reaches just to

the easternmost part of Afghanistan and neighbouring Tajikistan, from where the Pamir range extends further northwest into Tajikistan (Britannica 2). To the southwest the Karakoram is then followed by the Hindu Kush stretching out over about 800 kilometres (500 miles) from Pakistan far into Afghanistan, with the highest peak of Mount Tirich Mir with 7,690 metres (25,230 feet) (Britannica 3). Together, the Hindu Kush, Karakoram and Himalayan mountain ranges are also called the Hindu Kush Himalayas.

Additionally to the heavy rainfall of the seasonal monsoon, the glaciers and snowfields provide a source of water for the rivers in the region. The three major South Asian river systems of the Ganges, Indus and Brahmaputra origin in the Himalayas and form huge river basins downstream. The Indus basin in its upper mountain part has 18,495 glaciers, covering an area of 21,193 square kilometres (km²) or 8,182 square miles (mi²); the Ganges basin counts 7,963 glaciers with 9,012 km² (3,480 mi²) of glaciated area; and the Brahmaputra basin with 11,497 glaciers covers 14,020 km² (5,413 mi²) glaciated area. The 37,955 glaciers of these three major river basins cover a total area of 44,225 km² (17,075 mi²), and together provide 4,792 cubic kilometres (1,150 cubic miles) estimated ice reserves (ICIMOD 2012: 1).

With 1,081,718 km² (417,654 mi²) of its basin area partly in China, India, and Pakistan the Indus forms the largest river system in the region, home to estimated 178,483,000 people. Closely followed by the Ganges with 1,016,124 km² (392,328 mi²) basin area within India, Nepal, China, and Bangladesh, this area is much more densely populated by around 407,466,000 people. The Brahmaputra system stretches through China, India, Bhutan, and Bangladesh covering 651,335 km² (251,482 mi²), counting about 118,543,000 inhabitants (ICIMOD 1). Ganges and Brahmaputra finally flow together forming the giant delta at the Bay of Bengal with the protected mangrove forests of the Sundarbans. The huge Asian river systems of the Salween, Mekong, Yangtse, and Huang He (Yellow River) arise from the Plateau of Tibet north of the Himalayas.

The diversified topography of the Himalayan region provides rich biodiversity and various ecosystems and the Himalayan mountain ranges also “strongly influence atmospheric circulation and meteorological patterns across the region” (Shrestha et al. 2015: 16). In the eastern part of the Himalayas, where Bhutan is located, the climate is

influenced by the main monsoon period from June to September. Regarding changes in precipitation patterns across the greater region, during “the past decades, increased monsoon precipitation has been observed over the high mountain belt of the Himalayas, particularly in the east. The greatest decrease in monsoon rainfall has been observed in the south in the Ganges and Indus basins” (Shrestha et al. 2015: 36).

5.2. Border disputes

Unsolved border disputes of India with Pakistan and China in Kashmir in the western part of the Himalayan region, as well as between India and China in Arunachal Pradesh, and between Bhutan and China in the region’s eastern part are a permanent root of political tensions and insecurity, impediments for stability and cross-border cooperation.

India - Pakistan

The Kashmir region in the western part of the Himalayas with a total area of about 222,200 square kilometres (85,800 square miles) has been an area of conflict between India and Pakistan since 1947. For the partition of British India in 1947 between India and Pakistan the rulers of princely states could opt to belong either to India or Pakistan. When the maharaja of Kashmir, while facing a Muslim uproar in his territory, finally decided for accession to India, both Pakistan and India intervened. The former claimed Kashmir with a Muslim majority as part of its new state and the latter tried to enforce the accession, leading to warfare until 1949 and the definition of a cease fire line. The northern and western areas (Azad Kashmir, Gilgit and Baltistan) are controlled by Pakistan, while the southern and southeastern parts form the Indian state of Jammu and Kashmir (Britannica 4).

Though the military conflicts between India and Pakistan from the post-colonial partition of British India in 1947 onwards have diminished, in Kashmir severe human rights violations by armed forces and militants in both the administered zones became prevalent (HRW 2006a; HRW 2006b). Firing across the Line of Control at each other’s army posts continues to occur, causing casualties on both sides (The Times of India 2013; The Express Tribune 2015a). Diplomatic efforts in 2015 tried to revive high channels of secret diplomacy to find a solution to the conflict that has caused three

wars between the two countries. India and Pakistan decided to hold peace talks, now called Comprehensive Bilateral Dialogue, about Kashmir and issues of terrorism, peace and security (The Express Tribune 2015b).

However, armed attacks by militant separatists on Indian army posts in Jammu and Kashmir in 2016 have increased tensions between the two nuclear power neighbouring states. Furthermore, recent outbreaks of violence increasingly are characterised by participation of Islamic extremist groups in separatist protests and mobilisation of Islamic militants over social media. The decades old conflict about Kashmir, strategically important because of the region's glaciers and rivers providing drinking water, agricultural irrigation, and hydro-electricity for millions of people, is likely to continue (Snow 2016; Sahai 2016).

India - China

The Chinese infiltration into Ladakh, the mountainous eastern area of Kashmir, including road construction in the 1960s resulted in warfare between India and China in October 1962 in Ladakh (and simultaneously in Arunachal Pradesh in northeast India). The brief war ended with the occupation of the Aksai Chin plateau, the northeastern part of Ladakh, by China (Britannica 4). Since then, no resolution of the border issue has been achieved. Instead, the area is regularly witnessing incidents of transgression over the Line of Control and troop face-offs between Chinese and Indian soldiers, fortunately without any shots being fired so far (The Times of India 2015). As a result of these political stalemates the Kashmir region still lacks peace and security as conditions for enhanced socio-economic development.

Arunachal Pradesh, the northeasternmost Indian state, stretches from the eastern border of Bhutan to the north of Myanmar with an area of 83,743 square kilometres (32,333 square miles) and a population of 1,382,611. The northern boundary with China is about 885 kilometres (550 miles) long (Britannica 5). China in fact is claiming Arunachal Pradesh as former South Tibet (Richards 2015: 4). This claim means that China would extend its territory across the Himalayas and down the southern foothills, reaching to the Indian plains of Assam and the hills of Nagaland.

Today's northern border of Arunachal Pradesh with China dates back to 1914 when British India and Tibet agreed on this demarcation along the so called McMahon Line, named after the British chief negotiator Sir Henry McMahon. China later refused this agreement on the grounds that Tibet was under Chinese jurisdiction and therefore could not conclude a border treaty. After independence in 1947 India declared this borderline as its official boundary with Tibet. However, after the invasion of Tibet in 1950, China claimed this border to be illegal. During the warfare in October 1962 Chinese troops entered into Arunachal Pradesh but later voluntarily withdrew back to the previous borderline, which China calls the Actual Line of Control (Richards 2015: 4-5).

Since then temporary incidents of Chinese troops entering across the border into Arunachal Pradesh have deteriorated the political relationship between the two countries. India is improving infrastructure like road construction and promotes more settlement in the sparsely populated mountain areas. Despite mutual visits of the state leaders and high level border talks military armament on both sides does not defuse the tension at this part of the border between India and China (Watson; Chen 2015).

Bhutan - China

Bhutan, the small Kingdom in the Himalayas landlocked between China and India, has some strategic significance for both its neighbour countries. Old trade routes with Tibet across several Himalayan mountain passes on Bhutan's territory could be revitalised. More importantly from India's perspective, "Bhutan is a strategic buffer for the Siliguri Corridor" (Richards 2015: 5). Located southwest of Bhutan in the Indian state of West Bengal this narrow geographic corridor is the only land connection of the Indian northeastern states to the main part of India. Wedged between Nepal to the north and Bangladesh to the south the Siliguri Corridor, significantly also called the 'chicken's neck', at its slimmest part only fourteen miles (22.5 kilometres) wide, is a result of the British decolonisation process in 1947 when British India was partitioned along religious lines into the new states of India and Pakistan, at that time comprising West Pakistan and East Pakistan, which became Bangladesh in 1971 (Panda 2013).

This corridor also is the route overland from Bhutan and Northeast India to the closest riverine port of Kolkata, important for maritime trade routes from the Bay of Bengal

across the Indian Ocean. On the other side, north of the Siliguri Corridor, Tibet (China) stretches closer southward between Sikkim (the former Kingdom of Sikkim was incorporated into India in 1975) and the western border of Bhutan.

In this area, India, Bhutan, and China form a kind of strategic triangle in the Eastern Himalayas (Bhonsle 2012). The western side of the inverted triangle is the border with Sikkim, India, and on the eastern side is Bhutan, bound with historically close ties and a friendship treaty to India, while the base is with China. China's strategic interest is "to gain greater access to the Bhutanese arm of the triangle with a reset of the Sino Bhutan boundary" (Bhonsle 2012), thus increasing its territory in this strategic region with close access to India's Siliguri Corridor.

Exactly in this sensitive corner region between India, China, and Bhutan, adjacent to the Chumbi valley in Tibet, the area of the Doklam plateau is located in western Bhutan, which is claimed by China. Other disputed areas are in the northern mountainous region of Bhutan. Already in 1996 China proposed a package deal of exchanging areas in northern Bhutan in the Pasamlung and Jakarlung valleys against its desired area of the Doklam plateau in western Bhutan (Bisht 2010). As the Kingdom of Bhutan has no diplomatic relations with the People's Republic of China, in the thirteenth round of border talks 1999 in Thimphu, Bhutan, the Chinese delegation raised the issue of establishing diplomatic relations and trade as part of a package deal on the boundary settlement, but without concession on the claimed area in the western sector (Chandrasekharan 2010). Since then border talks have continued.

Historically, the relations between Bhutan and India were strongly intensified after China's annexation of Tibet in the year 1950, as "Tibet's fate was a warning to Bhutan that an isolationist policy could place its independence in jeopardy" (Sherpa 2013). Opening a new chapter after its "long tradition of cultural and religious interaction with Tibet" (Mathou 2004: 388) Bhutan closed its border crossings and cut off the trade with Tibet in 1960, after the Tibetan insurgence was defeated by Chinese troops and the Dalai Lama fled to Dharamsala in India in 1959. Accordingly, Bhutan embarked "a long period of self-imposed isolation from China" (Jha 2013: 3).

In 1959 Chinese troops also took over Bhutan's eight enclaves in western Tibet (Mathou 2004: 393). Granted by the king of Ladakh, who then controlled western

Tibet, and confirmed by the later Tibetan government, Bhutan governed several monasteries near Mount Kailash since the seventeenth century (Bray 2012: 4). The most important monastery was Darchen Labrang, the starting point for pilgrimages to circuit Mount Kailash and a summer trading mart as well (Bray 2012: 12).

Due to the largely not demarcated border between Tibet and Bhutan pasturelands in the mountains were occasionally disputed between yak herders from both sides, implying some political significance as well, as “Beijing’s policy in the Himalayan frontier region was to claim disputed areas on the basis of usage by Tibetans” (Mathou 2004: 397). “Military intimidation followed by diplomatic seduction has formed an important part of China’s policy towards Bhutan” (Jha 2013: 4). Since then “continuous Chinese intrusions into Bhutanese territory” (Bisht 2010) occurred. For example, as early as in the year “1966, on the tri-junction of Bhutan, Chumbi Valley and Sikkim, the Tibetan grazers accompanied by Chinese troops entered Doklam pastures” (Jha 2013: 4).

Bhutan holds border talks with China since 1984 and China has expressed its interest in further developing trade and establishing diplomatic relations with Bhutan. Moreover, the border talks also have served as occasions for both the governments to exchange views on other bilateral issues (Mathou 2004: 388). Nevertheless, China reportedly also has continued to exercise “pressure tactics by intruding into Bhutanese territory. For instance, Chinese soldiers have touched upon Royal Bhutan Army (RBA) outposts several times. Stealing yaks, medicinal herbs and timber by Tibetan herders is also a common activity” (Bisht 2010).

For example, in December 2007 the Indian television channel New Delhi Television (NDTV) reported about increasing Chinese forays into western Bhutan close to the Chumbi Valley, the tri-junction between India, Bhutan, and China. During the second half of 2007 Chinese soldiers made several inroads and withdrew after a while. This has alarmed the Indian army, as the area is close to India’s Siliguri corridor (NDTV 2007). For the year 2009, based on a briefing in the National Assembly of Bhutan on 4 December 2009, media reported about seventeen border intrusions by China, including some road construction, into Bhutan’s western mountainous territory, where Chinese soldiers came up to the Royal Bhutan Army outpost at Lharigang in the

Charithang valley (Rinchen 2009). Reports also mention illegal cross border activities of people from Tibet for instance collecting cordyceps (*Ophiocordyceps sinensis*; Bhutan: yartsa goenbub), a parasitic caterpillar fungus, which fetches high prices as traditional medicine and natural aphrodisiac, in the northern highlands of Wangdue Phodrang dzongkhag (district) in central Bhutan (Rinchen 2009). Or more recently, the Indian news channel Times Now reported that it had accessed an intelligence note saying that some Chinese soldiers intruded into eastern Bhutan on 28 May 2013, set up three camps and carried out patrols inside the Bhutanese territory (Times Now 2013).

There even seem to be border changes from Bhutan's side with territory ceded to China in 2007. Interestingly, dissenting boundaries for the north of Bhutan are shown in different maps. For example, Nations Online Project shows the northernmost area of Bhutan in the Gasa district, from mountain Gangkar Puensum northeast till the peak of Kula Gangri, and then westward back to Bhutan's northwestern border, including several summits of the Eastern Himalayan Mountain range, with a dotted line as disputed region (Nations Online Project 1). Likewise, Google Maps shows the same area with a dotted border line, as well as the western Doklam area in Bhutan. By the way, even the whole of Arunachal Pradesh state in northeast India has got a dotted boundary line as disputed region between India and China from Google Maps (Google Maps 1).

Whereas, for instance, Maps of World and Ezilon Maps show the previous typical shape of Bhutan including the northernmost mountain region with Kula Gangri (Maps of World 1; Ezilon Maps 1). On the other side, the Tourism Council of Bhutan, the official state agency for tourism, on its online map has this whole northern area cut off from Bhutan's territory (TCB 1). However, for the more detailed map of Western Bhutan, the tourism agency is using Google Maps with the dotted border lines for disputed areas (TCB 2).

Reports on the issue of Kula Gangri and the northwestern mountains are inconsistent. They range from the view that "in 2007, Bhutan lost its northern snow-capped mountains to China" (Sherpa 2013), without further explanation how that happened; to the view that "without having rational discussion on such important matter as the disputed border, Bhutan government published a revised map of the country excluding

Kulakangri” (Rizal 2013); and similarly, that “later in 2007, the Bhutan government published a revised map of the country excluding the Kula Kangri Mountain, the tallest mountain peak, after having generously gifted it to China” (CASS-India).

The twenty-third round of border talks between Bhutan and China took place in August 2015 in Thimphu, Bhutan. Already in 2014 the report on the joint technical field survey in the disputed central northern border areas of Bayul-Pasamlung comprising 496 square kilometres (192 square miles) was endorsed during the previous border talks held in China. Hence, the 2015 round was supposed to concentrate on the disputed areas of Dramana, Shakhatoe, Sinchulung, and Doklam in the western dzongkhags (districts) of Haa and Paro, comprising 269 square kilometres (104 square miles) (Kuensel 2015a). Subsequently, the Bhutanese Ministry of Foreign Affairs announced that the final phase of the joint technical field survey of disputed areas in western Bhutan was planned for September 2015, following the first joint survey from June 2015. The bilateral expert group was expected to meet end of 2015 to compile the report of the joint border survey, which then was supposed to be discussed in the 2016 border talks aiming at a mutually acceptable resolution (Kuensel 2015b).

The twenty-fourth round of border talks between Bhutan and China took place in August 2016 in Beijing, China, after the joint technical field survey of the disputed areas in western Bhutan was carried out and two meetings of the jointly installed bilateral expert group were conducted in December 2015 in Beijing and in March 2016 in Thimphu, Bhutan. According to the scarce information released by the Bhutanese foreign ministry about the 2016 border talks published in the local media, the joint field survey report was endorsed and the expert group was instructed to continue discussions (Kuensel 2016b), yet, the future destiny of the Doklam plateau in western Bhutan, claimed by China, still remained in ambiguity.

Moreover, a decision of the Bhutanese government to cede pasture land in western Bhutan to China would also have implications for the local rural communities in the border region, and on the other hand, “the potential consequences of an exchange deal would raise strategic concerns in India” (Bisht 2010). Obviously, the Bhutan-China border issue remains politically closely related to the India-China border dispute. Anyhow, it is noteworthy that India has long lasting multifaceted political and

economic influence in Bhutan. Due to Bhutan's dependency on importing all essential goods through its southern border towns, and exporting electricity generated by hydropower, India will remain Bhutan's largest trading partner. It is also worth mentioning, that the Indian government is Bhutan's biggest financier of development programmes and infrastructure. Moreover, the Indian army since 1962 has established a permanent training mission in support of the Bhutanese army, the so called Indian Military Training Team (IMTRAT), which provides India some military presence in Bhutan. In any case, it seems that Bhutan's "greatest foreign policy success lies in not being taken as either granted or completely unreliable by India or China" (Jha 2013: 4).

On the other side, the region also could become economically more important if the trans-Himalayan trade between Tibet and Sikkim could be enhanced, facilitated by Chinese infrastructure projects of building road and railway links, and consent of India to open cross border trade routes, provided the peaceful settlement of border disputes between all three countries.

Generally, growing cooperation within the Himalayan region in the areas of economy, regional financial institutions, and also climate change might have the potential to gradually increase political stability and, despite the political stalemate on the status quo, facilitate border negotiations even without further occurrence of intrusions or armed incidents. Overall, the complex border conflict in the Himalayas "presents a classic study of great power rivalries, the perils of buffer states and the legacies of empires" (Richards 2015: 18).

5.3. Human Development

Though linked by similar challenges of their rural mountain population and facing similar threats of climate change, the five countries of the Himalayan region show significant differences in their overall development, as reported by the United Nations Development Programme (UNDP). Compiled for 187 countries in total, ranking them in four categories from very high, high, medium, to low human development, the 2014 UNDP Human Development Index is based on the three components longevity, education, and income. Achievements of the countries in these sectors are also adjusted according to existing inequalities among their residents (UNDP 2014: 156-

157). The UNDP Human Development Report 2014 makes a shift towards a more people-centred approach, identifying structurally vulnerable groups regarding their gender, ethnical or indigenous group membership, or geographic habitation. The report also considers changing conditions of people's vulnerabilities during their life cycles (UNDP 2014: iv).

The Human Development Index illustrates differences in the status of development within the Himalayan region. China is leading with an index rank of 91, still ranging in category two among the nations with high human development. India on rank 135 and Bhutan on the next rank of 136 both made it into the third index category comprising countries with medium human development. However, two out of the five Himalayan countries are listed among the nations with low human development, namely Nepal on position 145, and closely behind, Pakistan with position 146 (UNDP 2014: 160-163).

5.4. Climate change commonalities in the Himalayas

Since immemorial times mountains have provided living space for mountain communities and have played an important role in their cultural practises. Yet, climate change has significant impacts on their way of life and requires complex adaptation measures.

During the last decades, glaciers in the eastern and central part of the Himalayas have retreated and significantly lost ice mass, except few glaciers in some very high and steep mountain parts of the Karakoram west of the Himalayas which have experienced increasing winter snowfall and lower summer temperatures (Shrestha et al. 2015: 38). In general, rising temperatures expose more glaciers to temperatures above zero degree Celsius causing glacial melting and, at the same time, change precipitation from snow to more rain with the result that melting ice is not replenished again (Shrestha et al. 2015: 76).

Recent research has shown evidence that black carbon, main component of soot emitted from combustion all over the South Asian plains, poses additional threat to the Himalayan glaciers (Shrestha et al. 2015: 42). Deposited on snow and ice black carbon darkens the surface leading to more sunlight absorption and accelerated melting due to higher surface temperatures. At the same time, suspended in the air over the

mountains black carbon absorbs more sunlight leading to higher air temperatures, thus again warming the surface of glaciers. In addition to global warming, these impacts of black carbon considerably add to glacial melting and are “the likely explanation for the more rapid increase in temperatures at higher altitudes over the last few decades” (Shrestha et al. 2015: 42).

Faster melting of snow and mountain glaciers also increases the number and volume of glacial lakes dammed by moraine walls, thus raising the risk of glacial lake outburst floods (GLOFs), a significant threat to communities in the mountain valleys and downstream areas. In the long run, fresh water sources are decreasing and the volume of spring water gets reduced especially during the dry seasons, which leads to increased water scarcity specifically for the households of mountain rural communities, their livestock, and irrigation. Continuing climate change across the Himalayas will likely show additional “cascading effects on river flows, groundwater recharge, natural hazards, and biodiversity” (Xu et al. 2009: 522) and therefore affect ecosystems and livelihoods of people. Mitigation measures against floods and landslides include retaining walls along riverbanks, stabilisation of slopes through plantation, and early warning systems together with capacity building for local communities.

Yet, besides the destructive effects of floods, if water flow of Asian river systems will change in the long term, “the impact of increased temperatures and reduced water supplies on downstream food production” (Xu et al. 2009: 527) will be of great concern. And if warming temperatures cause thawing of permafrost in the highlands, this again changes ecosystems, and also leads to rising emission of carbon and methane stored in the frozen ground. Throughout the Himalayas, climate change triggers a complexity of interaction between melting glaciers and permafrost, change of river flows and water sources, shifting ecosystems, increased extreme weather events, and changing monsoon climates (Xu et al. 2009: 527).

Changing river flows with potentially decreasing flow volume in dry seasons together with increasing sedimentation of rivers also can question the profitability of hydropower plants, the front runner green energy technology. Hydropower in the Himalayas is the main energy source and has huge further development potential.

Several projects from bigger plants with dam and water reservoir to micro-hydro units for local grids are planned respectively under construction for instance in Bhutan and Nepal.

While Bhutan continuously develops its hydropower capacity for domestic demand and export to India the situation is more difficult in Nepal. For instance, a Norwegian company in early 2016 has withdrawn its plans to build the 650 megawatts Tamakoshi hydropower plant reportedly due to increased bureaucratic hindrances for foreign investment, insufficient transmission capacity, lack of regulations for power sale to India, and the fragile political environment (The Himalayan Times 2016). At the same time, while Nepal's government has declared its intention to reduce procedural delays and undertake legal reforms, financial institutions like the World Bank and Asian Development Bank insist on policy and institutional reforms in the energy sector as they are interested to give credit worth one billion US dollars (Kathmandu Post 2016). Large investments are required to improve Nepal's highly deficient energy situation causing a permanent power crisis with daily load shedding for hours, severely compromising living conditions and hampering economic growth.

At higher altitudes, positive impacts of global warming also can generate new livelihood opportunities for some rural mountain communities in certain areas, with more agricultural options and less cold winter times. Whereas in the lowland areas increasing temperatures and less water availability during dry seasons will reduce agricultural productivity especially for staple crops like paddy with higher water requirement.

In view of climate change, together with social and economic change, different approaches and development programmes from different stakeholders across the Himalayan region on how to support adaptation and sustainable livelihoods of rural communities are implemented. One common concept is the development of value chains for products originating from mountain areas.

A value chain analysis covers activities and interlinkages between producers, traders, processing industries, and consumers. Originally developed in the business world for analysing the process from production to delivery of products in order to improve economic profits and competitiveness, the value chain approach has been globally

incorporated into development cooperation to support poor communities to upgrade their role within value chains and to reduce poverty (Mitchell et al. 2009: 1). Value chain interventions in the development sector often “have overemphasised the role of the poor as producers as the main means of reducing rural poverty” (Mitchell et al. 2009: 1). Yet, concepts need to analyse possible engagement of the poor along the product chain as local vendors, workers, or consumers, as well as the regulatory environment and potential impediments by state authorities (Mitchell et al. 2009: 1). The advantage of the value chain approach is its market oriented focus on viability and commercial sustainability, its analysis of lacking economic power and other blockages of specific target groups, and its wide usability as a framework for planned interventions for the benefit of the resource poor (Mitchell et al. 2009: 2).

In the Himalayan region, endowed with rich biodiversity, various non-timber forest products have potential as qualitative niche products for value chain development to diversify livelihoods of mountain farmers. However, value chains in the Himalayas also need to consider poor accessibility of remote settlements, difficult transportation conditions and need for cold storage facilities for farmer’s produce, lack of access to finance, lack of information on quality control, upgrading of products and market conditions, and often less consideration of mountain circumstances in national trade and agricultural policies, all contributing to greater economic marginality of mountain communities.

Focusing on the Eastern Himalayas from Nepal over Sikkim (India) to Bhutan and Arunachal Pradesh (India), and with Tibet (China) along the northern side, the high mountain range acts as a climate barrier. Cold continental air from the Central Asian highlands is prevented to pass southwards to the Indian subcontinent in winter, and the southwestern winds during the monsoon season provide heavy rain and snowfall on the southern mountain flanks, while causing arid conditions in the northern Tibetan Plateau (Britannica 1). Regional research indicates that in “many areas a greater proportion of total precipitation appears to be falling as rain than before. As a result, snowmelt begins earlier and winter is shorter. Whereas snow masses have acted as a natural form of storage, releasing moisture slowly into the ground or rivers, water is increasingly only available at the time of precipitation” (Sharma et al. 2009: 4).

With some spatial variabilities and remaining uncertainties due to the complex geographical environment research shows that the Eastern Himalayas experience faster warming in higher altitudes especially during the winter months with the greatest warming rates in mountain areas above 4,000 metres (13,123 feet) up to 0.06 degrees Celsius per year; and that overall annual precipitation is estimated to increase by eighteen percent by mid-century, but with more variable rainfall patterns and with higher monsoon precipitation in higher altitudes (Sharma et al. 2009: 5-7).

Along the mountain ranges and foothills of the Eastern Himalayas, narrow habitat areas provide home for some threatened species like the snow leopard (*Uncia uncia*), red panda (*Ailurus fulgens*), tiger (*Panthera tigris*), Asian elephant (*Elephas maximus*), and one-horned rhinoceros (*Rhinoceros unicornis*) as well as for regional endemic species like the golden langur (*Trachypithecus geei*), the takin (*Budorcas taxicolor*), which is the national animal of Bhutan, the Namdapha flying squirrel (*Biswamoyopterus biswasi*), the Himalayan field mouse (*Apodemus gorkha*) or the hoolock gibbon (*Bunopithecus hoolock*), all vulnerable to climate change induced alterations of their specific habitat (Sharma et al. 2009: 8-9).

The general key risks for Asia due to climate change, as assessed by the Intergovernmental Panel on Climate Change (IPCC), are increased flooding caused by climatic drivers like extreme precipitation or damaging cyclones, and sea level rise in coastal areas, which will lead to widespread damage to infrastructure, livelihoods, and human settlements; increased risk of heat-related mortality caused by the warming trend and extreme temperatures, and together with a drying trend, the higher risk of drought-related water and food shortage, leading to increased malnutrition (IPCC 2014: 22). Generally, climate change impacts are expected to reduce economic growth and complicate poverty reduction, worsen food security and increase the displacement of people exposed to extreme weather events (Shrestha et al. 2015: 85).

Considering the climate change commonalities in the Himalayas it is noted that reducing total water demand and increasing water use efficiency, improving irrigation and developing climate resilient agriculture, protection of ecosystems and promotion of renewable energy sources, diversification of rural livelihoods and implementing risk management systems for natural disasters are some of the key elements of adaptation

in the Himalayan region. Adaptation efforts could be even more effectively implemented if regional transboundary discourse and cooperation could be improved. Knowledge management and networking at different political and social levels among the regional countries can foster positive responses to climate change. Enhanced regional exchange of best practises and community experiences, and tested simple technologies for improving energy efficiency, subsistence agriculture and water harvesting will facilitate to increase the adaptive capacities of rural communities especially in the remote mountain regions.

6. Country context: Bhutan

The Kingdom of Bhutan is situated in the eastern part of the Himalayan region, landlocked between India and the Tibet Autonomous Region (China). The country's native name 'Druk Yul' means 'Land of the Dragon', but also refers to the Buddhist Drukpa sect dominant in this region (TCB 3; TCB 4). The national language is Dzongkha, apart from local languages and dialects, Nepali mainly in southern parts, and English as the medium of teaching. Bhutan has a land area of 38,394 square kilometres (14,824 square miles) and an estimated population of 783,882 (NSB 1, as of 31 December 2016). Population figures are projected by the National Statistics Bureau (NSB) and updated online, based on the first decennial population and housing census of Bhutan from 2005 with a resident population of 634,982 at that time (GNHC 2013a: 5).

6.1. Geography and climate

The rugged mountainous country has an east-west dimension of about 300 kilometres (186 miles) and a north-south extension of about 170 kilometres (106 miles) with elevations from 160 metres (525 feet) above sea level in the south to more than 7,500 metres (24,606 feet) in the north with the snow-capped mountains of the Great Himalaya Range along the border with China (NSB 2015: VI). The Himalayan glaciers covering about ten percent of the country's area feed the four major river systems of the Drangmechhu, the Punatsangchhu, the Wangchhu, and the Amochhu flowing southwards to finally join the Brahmaputra River in India (NSB 2015: VIII).

Corresponding to the three main geographic areas of the southern plains and foothills, the inner Himalayas, and the higher Himalayas Bhutan can be divided into three climatic zones. In the southern foothills and plains, an around twenty kilometres (12.8 miles) wide strip of land along the border with India, which rises from 160 metres (525 feet) to 1,500 metres (4,921 feet) altitude, the subtropical climate is hot and humid with heavy rainfall. A cool temperate climate with cool winters, hot summers, and moderate rainfall dominates the inner Himalayas up to 3,000 metres (9,843 feet), interspersed with densely populated and agriculturally used broad valleys in the southern and central regions. The sparsely populated northern part of the country with high valleys and the higher Himalayas reaching up to 7,550 metres (24,770 feet) is characterised by an alpine climate with cool summers and cold winters. Around seventy percent of the country's precipitation originates from the southwest monsoon from the Indian Ocean during the summer months of June to September (NEC 2009: 18-19; NSB 2015: VI-VII).

6.2. Politics and administration

On 17 December 1907, after a period of civil war and battles between rivalling local leaders, the victorious penlop (governor) of Trongsa in central Bhutan, Ugyen Wangchuck, was elected Bhutan's first king, thus establishing the hereditary monarchy of the Wangchuck dynasty for the next hundred years (Savada 1991: 10; NSB 2015: VIII). This historic event finally ended the previous 280 years of dual system of a state monastic body and a civil administration, both under the absolute leadership of a cleric head of state called zhabdrung, believed to be reincarnations of Ngawang Namgyal (1594-1651), the so called zhabdrung rinpoche, Buddhist lama (teacher) and born prince of Ralung in Tibet, who came to Bhutan in 1616, united the country and established the zhabdrung system by 1626 (Savada 1991: 6; Kuensel 2016c). At strategically important locations throughout the country dzongs (fortresses) were constructed housing civil and religious administration.

The third king Jigme Dorji Wangchuck in strengthening the central authority established a first national assembly comprising representatives of people, civil administration, and the monastic body in 1953. The fourth king Jigme Singye Wangchuck, who initiated the drafting process of the kingdom's first constitution in

2001, embarked new government structures by devolving the executive power from the throne to a council of ministers in 1998. In 2006, the king abdicated the throne in favour of his eldest son the crown prince Jigme Khesar Namgyel Wangchuck who acceded to the throne as the fifth Druk Gyalpo (Dragon King) on 14 December 2006 (NSB 2015: VIII).

With the establishment of political parties, the first democratic elections of the national council in December 2007 and the national assembly in March 2008, and the formal adoption of the first constitution in July 2008, Bhutan has evolved from a hereditary absolute monarchy to a constitutional monarchy with a democratically elected bicameral parliament. After this political transition of the country, and in a year which was considered auspicious, the coronation ceremony of the fifth king took place on 1 November 2008.

The national assembly as the lower house consists of forty-seven elected representatives according to the forty-seven constituencies in the country. As the legislative power, the national assembly enacts laws and approves the national budget, reviews the five-year development plans of the country and deliberates on issues of national interest and security (NSB 2015: IX). The national council forming the upper house consists of twenty elected members from the twenty dzongkhags (districts) and five members nominated by the king. As the house of review the national council reviews policies and bills, scrutinises state functions and debates on issue of national interest and security to be brought to the notice of the king or the national assembly (NSB 2015: IX).

Decentralisation and local governments

Besides the central government with ministries and autonomous institutions the administration system includes local governments with decentralised decision-making structures at dzongkhag (district) level, first established in 1981, and since 1991 at gewog (county) level, with the main purpose to plan and implement development activities (NSB 2015: IX).

The country is partitioned into twenty dzongkhags (districts) and 205 gewogs (counties). At first there were four dzongkhag thromdes (district cities) established,

namely Thimphu, Phuentsholing, Gelephu, and Samdrup Jongkhar (NSB 2015: 66). Later on the national assembly declared fifteen more dzongkhag thromdes in the fifth session of the second parliament in spring 2015, together with new yenlag thromdes (satellite towns) for eighteen dzongkhags. For Pemagatshel dzongkhag in southeastern Bhutan two towns were proposed as dzongkhag thromde, yet no three-fourths majority of votes could be achieved for decision and the case was left for further consultations with the people (NAB 2015a: 99-100, 102, 104). Finally, also Pemagatshel got a dzongkhag thromde during the sixth session of the second parliament in winter 2015, and one yenlag thromde each for Pemagatshel and Paro district was endorsed as well (NAB 2015b: 44). Thus by the end of 2015, to ensure balanced regional development, Bhutan's parliament has managed to declare thromdes for all twenty dzongkhags as required per the Local Government Act (The Local Government Act of Bhutan 2009: 5).

Political decentralisation has been strengthened in the context of the new constitution of Bhutan. This includes responsibility and accountability of the local governments for planning and implementing development strategies and activities. "Power and authority shall be decentralized and devolved to elected Local Governments to facilitate the direct participation of the people in the development and management of their own social, economic and environmental well-being" (The Constitution of the Kingdom of Bhutan 2008: 42). Nevertheless, local governments are not conceptualised as legislative bodies, but rules and regulations in consistency with national laws can be made, and support from the central government for their capacities shall be rendered (The Local Government Act of Bhutan 2009: 2).

In general, local governments shall promote integrated development planning while establishing democratic government structures for local communities (The Local Government Act of Bhutan 2009: 11). To achieve their goal of service delivery local governments receive annual grants from the national budget and are entitled to collect taxes and fees (The Local Government Act of Bhutan 2009: 49).

6.3. Demography

Life expectancy in the year 2005 was 65.65 years for men, and 66.85 years for women, and has since then increased to 68.4 years for men and 69.4 for women in 2010, while projections indicate a male life expectancy of 73.64 and a female of 74.71 by the year 2030 (GNHC 2011b: 17). With a population growth rate of 1.3 percent the population is projected to grow to 886,523 people by the year 2030 (NSB 2015: 3, 9).

For a small mountain country with limited natural resources a growing population can cause multiple challenges, hence, efforts are undertaken to reduce fertility in order to stabilise future population size (GNHC 2011c: 3). Demographic challenges like high population growth rates, rise in young as well as elderly population, and the prevalent rural-urban migration can threaten development achievements and goals (GNHC 2011c: 4). Especially rapid population growth can thwart development and economic growth by enhancing general social costs for an increasing dependant population and aggravating “the task of building human and capital resources such as sanitation, health care services, education, transportation and infrastructure, the most vital endowments for development” (GNHC 2011c: 5). The growing young population also “implies the need for a corresponding increase in the scale of economic investment and job creation” (GNHC 2011c: 22), while the growing number of elderly people with higher life expectancy will require higher budgeting for health care (GNHC 2011c: 7).

Fast urbanisation due to rural-urban migration can stress the capacities of urban services and will exacerbate social and environmental problems such as insufficient supply of electricity, safe drinking water and sewerage facilities, shortage of affordable housing, urban unemployment, accretion of slums, and increasing pollution (GNHC 2011c: 8). In order to reverse internal migration patterns “the creation of off-farm employment opportunities, and the provision of socio-economic facilities and infrastructure in the rural areas” (GNHC 2011c: 8) are required. But again, a growing total population also will increase the pressure on available agricultural land and lead to changing land use from marginal land, hillsides, and forests to cultivation of staple foods or cash crops. Despite all efforts for environment protection the growing population of the country already threatens its limited natural resources and fragile ecosystems. “There are already signs of eroded hillsides, worn-out farmlands, parched

grassland, polluted water and treeless ranges, air and industrial pollution, water and garbage pollution, loss of soil fertility and shrinking access to safe drinking water” (GNHC 2011c: 14).

With the Gender Statistics Bhutan 2010 a compilation of sex-disaggregated data was published for the first time in the country, showing achievements and gaps in gender equality. In general, Bhutan is considered a country without major obstacles for women, not to mention the absence of repressive structures of social or religious origin. Yet, areas of improvement have been identified.

At the political level, the first democratic elections in 2007 and 2008 brought four female delegates out of forty-seven delegates into the national assembly, and six women out of twenty-five delegates into the national council (GNHC 2011b: 9). Regarding the youth, a tendency to marriages at a young age between fifteen and nineteen years is prevalent among girls, especially in rural areas with nineteen percent of the girls married in that age, and ten percent in urban areas, while out of the boys of the same age group five percent in rural and around two percent in urban areas were married in 2005 (GNHC 2011b: 18). The figures indicate that although the legal age for marriage is eighteen years, pregnancies of teenage girls are not uncommon and often lead to traditional marriages especially in villages. With a reportedly low use of contraceptives, adolescent fertility accounted for eleven percent of births in 2005, and sexually transmitted diseases are observed to increase among adolescents (GNHC 2011c: 9).

In the field of education, the net enrolment rate in primary education in 2010 was ninety-three percent among girls and ninety-five percent for boys (GNHC 2011b: 11). The female enrolment in tertiary education in different institutes was around thirty-five percent of all students, whereas in the more technical oriented vocational training institutes around thirty-three percent were female students in 2009 (GNHC 2011b: 14-15). In a nutshell, the gender statistics report comments on the status of gender equality: “Women’s active participation in governance, ensuring equitable participation in tertiary and technical education, providing decent employment and creating a violence free society, still remain as critical challenges for the country” (GNHC 2011b: 3).

The World Economic Forum's Gender Gap Report 2015 quantifying gender based inequalities in key socio-economic areas ranks Bhutan 118 out of 145 countries with an overall index score of 0.646, between a score of zero indicating total inequality and a score of one indicating full equality, achieving very high equality levels in the sectors of health and education, a medium level in economy, and a very low one in politics (WEF 1). In the Himalayan region, China leads with the rank of 91, followed by India with 108, and Nepal with 110, while Pakistan with the rank 144 being the last but one of all measured countries (WEF 2).

The number of crime incidents registered with the Royal Bhutan Police in 2014 was dominated by 834 crime cases against property, followed by 644 incidents against persons and 404 against state and public order. Miscellaneous minor incidents accounted for 389 cases, and 66 commercial crime and fraud offences were reported (NSB 2015: 254).

6.4. Transport and communication

Since the first motor vehicle appeared in the landlocked and mountainous country in the year 1962 a road system between Bhutan and India and within the country was continuously constructed and serves as the main means of transport, reaching 10,713 kilometres (6,657 miles) roads and 312 motorable bridges by 2014 (NSB 2015: 142, 115, 144). Public transport services were privatised in 1991, by December 2014 a total number of 69,602 vehicles were registered, and 791 motor vehicle accidents occurred in the year 2014 (NSB 2015: 142, 258).

The telephone network was established in 1963, the first satellite link in 1990, and the television network followed in 1999. With internet services introduced in 1999 as well, the national telecommunication system provides access to the global information network. The state owned national airline Drukair was founded in 1981 and started operations in 1983 with flights to neighbouring India. Paro International Airport was inaugurated in 1999, and after a tender for aviation the new private carrier Bhutan Airlines joined in 2011 (NSB 2015: 142-143). International flights connect Paro with India (Delhi, Mumbai, Kolkata, Bodhgaya, Bagdogra, and Guwahati), Nepal (Kathmandu), Bangladesh (Dhaka), Thailand (Bangkok), and Singapore; and domestic

routes link Paro airport in western Bhutan with Bathpalathang airport in the central district of Bumthang, with Yonphula in eastern Trashigang, and Gelephu, the commercial town in the southern district of Sarpang (Drukair 1).

6.5. Financial sector

The Royal Monetary Authority (RMA) serves as Bhutan's central bank. The two traditional financial institutions Bank of Bhutan (BOB) and Bhutan National Bank (BNB) were complemented in 2010 by two private commercial banks, Druk Punjab Bank (DPB) and T Bank. Further financial institutions are the Royal Insurance Corporation of Bhutan (RICB), Bhutan Development Bank (BDB), and the National Pension and Provident Fund (NPPF) (NSB 2015: 188). The Royal Securities Exchange of Bhutan (RSEB) was established in 1993 under the Royal Monetary Authority as a non-profit national stock exchange with twenty-one Bhutanese companies listed. Later delinked from RMA the stock exchange now is owned by four brokerage firms which belong to the three banks BOB, BNB, and BDB, and the insurance company RIBC (RSEB 1).

In the past, traditional economic transactions in Bhutan took place through barter trade and taxes were collected in kind and labour. In 1961 the system of five-year development plans was introduced, also embarking the institutionalisation of the public finance system. The Bhutanese paper currency ngultrum launched in 1974 further facilitated the transition from barter trade and ancient taxation to a monetised economy system (NSB 2015: 210).

6.6. Economy

Sustainable socio-economic development is one of the four pillars of the concept of gross national happiness, besides good governance, cultural preservation, and environmental conservation (CBS 1). However, to achieve sustainable economic growth remains a challenge as economic growth so far is largely boosted by external aid, with a high fiscal deficit, weak balance of payment, mounting public debt, and difficult sustenance of foreign exchange reserves as factors of constraint. Additional obstacles are the small size of the domestic market; inadequate infrastructure together with high transportation costs; difficult access to finance and scarcity of land; lack of management skills, research and development capacities combined with

shortage of professionals and overall low labour productivity; and inconsistent policies (RGoB 2010: 1). On the other hand, Bhutan offers competitive advantages such as political stability; peace and security; cultural values together with high environmental protection; widespread English language skills; favourable green energy supply; and free access to the large Indian market (RGoB 2010: 2), which can be utilised in creating an enabling environment for business investments.

Albeit the importance of gross national happiness as a more holistic development concept economic indicators are collected and published nonetheless to analyse the economic development of the country. The sum of the value of all goods and services produced in Bhutan available for consumption, investment, and exports, is represented by the gross domestic product (NSB 2015: 233). The gross domestic product (GDP) “is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources” (World Bank 1).

Bhutan’s GDP in the year 2014 was 119,545.75 million Bhutanese ngultrum (BTN) (NSB 2015: 238), or the rounded sum of 119.5 billion BTN. Using the average exchange rate of 61.47 BTN per US dollar (USD) in the Bhutanese fiscal year from July 2013 to June 2014 (NSB 2015: 187), the GDP was 1,944.78 million USD (1.94 billion USD). In 2014 the GDP real growth rate was 5.46 percent (NSB 1). And by dividing the gross domestic product by the midyear population the GDP per capita is calculated (World Bank 1). For Bhutan the GDP per capita in 2014 was USD 2,612 (NSB 1).

From 11.31 percent in the fourth quarter of 2013 the inflation rate significantly decreased since then to 4.74 percent by June 2015 (NSB 2015: 239, 241). Major price-raising category groups above ten percent change in the first half of 2014 were food and non-alcoholic beverages (with a category weight of thirty-seven percent of the total inflation rate), alcoholic beverages (weight three percent) and transport (weight twelve percent). While the first two groups were substantially coming down to around two percent inflation rate by June 2014, transport remains the biggest inflater with around fourteen percent increase in price (NSB 2015: 240-241).

Sustainable economic growth would require additional employment generation and enhanced domestic production including value addition to products, instead of being mainly based on government expenditure, increasing imports, and provision of grants by international donors, an issue prevalent in the current political debate of the young democracy (Kuensel 2016d).

In rural Bhutan a predominance of people is engaged in working on their own farmland and, further increasing the number of self-employment, small cottage industries are undertaken at home as well, resulting in a lower number of people working for wages (NSB 2015: 60). Nevertheless, a steady increase of unemployment is observed from 1.9 percent in 2001 to 2.6 in 2014, as per the Labour Force Survey 2014, with a higher female unemployment rate of 3.5 percent compared to the male rate of 1.9 percent; urban unemployment increased to 6.7 percent compared to 1.2 percent in rural areas; and comparatively high is youth unemployment with 9.4 percent (GNHC 2015: 2). On the other side, data from the year 2010 show that 18.4 percent of children from five to fourteen years were engaged in child labour, more common in rural areas with 22.2 percent of children than in urban areas with 8.7 percent (GNHC 2015: 2).

Foreign trade

Bhutan's economic relation to other countries is dominated by India as the sole major trade partner for imports and exports alike. Statistics for the year 2014 show that 89.9 percent of all imports came from India, followed by 2.6 percent from Japan, and 1.8 percent from China. And modest 0.6 percent of imports from Austria still secure the number eight among the top ten countries of import partners, before Sweden and Switzerland (NSB 2015: 181). Regarding Bhutan's exports 85.5 percent went to India, followed by 6.7 percent to Bangladesh, and 2.4 percent to Germany (NSB 2015: 184).

Among the top ten commodities of imports are fuel products like diesel and petrol including aviation fuel, turbines and equipment for hydropower plants, ferrous products, wood charcoal, coke and coal, and husked rice. Exports mainly consist of ferro-silicon, semi-finished iron products including bars and rods, cement, calcium carbide, gypsum, cardamom, and potatoes. Given the huge need for imported products and the comparatively small production sector the balance of trade is

increasingly negative with imports more than double worth of exports (NSB 2015: 182-183).

Industry

Bhutan's industrial sector mainly includes manufacturing, mining, wholesale and retail trade, and service and cottage industries. Adding all sectors a total number of 69,847 industrial establishments was registered in 2014 (NSB 2015: 124). A small number of major firms dominate the manufacturing industry, while smaller companies engage in food processing and cottage industries (NSB 2015: 123). Apart from electricity, coal and wood fuel are used as well by industries, raising the need to contribute to further reducing greenhouse gas emissions by curtailing the use of fossil fuels through new technologies (GNHC 2011a: 81).

Regarding the mining sector and mineral resources, clear policies and compliance monitoring are required to protect environment and local communities while excavating minerals. Media reports state that out of forty-four operational mines and quarries about sixty percent have violated environment clearance terms (Kuensel 2015g).

Tourism

The tourism industry significantly contributes to public finance by earning US dollars from international tourists, besides growing numbers of regional tourists mainly from India. With the beginning of tourism in 1974 the sector initially was controlled by the government's tourism agency until it was privatised in 1991 (NSB 2015: 171). The government adheres to a tourism policy of 'high value and low impact' to create the image of one of the world's most exclusive travel destinations (TCB 5) while avoiding cheap mass tourism and its destructive impacts. By enacting a tourism royalty of sixty-five US dollars per international tourist per day as part of the mandatory minimum daily rates tourism contributes to the national budget providing free education and healthcare, poverty alleviation, and building of infrastructure (TCB 6).

For travelling in a group of at least three persons the minimum daily package of 200 US dollars per person during low season (January, February, June, July, August, and December) and 250 US dollars in peak season (March, April, May, September, October,

and November) covers three star accommodation or the camping equipment for trekking tours, meals, transports except domestic flights, and a licensed tour guide, and includes the above mentioned royalty. Daily surcharges for single travellers are forty US dollars and thirty US dollars per person for groups of two people, while general discounts for children, students, larger groups, and longer visits apply (TCB 6). The package tours and visa formalities only can be organised by licensed Bhutanese tour operators, and can be either booked directly or via travel agents abroad with an extra charge of usually ten percent agency commission.

The hard currency revenue increased from about two million US dollars in the late 1980s to more than seventy-three million in the year 2014, generated from 57,431 international tourists (NSB 2015: 171, 177). Including regional Asian tourists the total number of tourist arrivals was 133,480 in 2014, showing a growth rate of nearly fifteen percent compared to 2013 (NSB 2015: 171). Tourism is also considered as opportunity for income generation for rural households with growing potential in terms of home stays, handicrafts production, horses for mountain trekking routes, and local cultural guides.

Bhutan's economy also includes three important sectors especially sensitive to climate change. Hydropower, agriculture, and forestry are dependent on regular and sufficient water supply, hence on monsoon and snowfall patterns.

Hydropower

Due to its river network flowing from the northern Himalayas to the southern plains hydropower is Bhutan's key resource of clean energy and the main driver of the country's much desired socio-economic development.

With the Dagachhu hydropower plant construction finalised in addition to the hydropower plants of Basochhu, Chukha, Kurichhu, and Tala, there are five bigger power stations in operation as of 2015 (DGPC 2014: 23; Kuensel 2015c). Generation of hydroelectricity is managed by the Druk Green Power Corporation (DGPC), owned by Druk Holding and Investments (DHI), the government's umbrella company for commercial investments. The Dagachhu hydropower plant is the first public-private partnership in Bhutan's hydropower development, with Druk Green Power

Corporation having a fifty-nine percent majority shareholding, the National Pension and Provident Fund holding fifteen percent, and the Indian Tata Power Company holding twenty-six percent of shares (DGPC 2014: 11).

The five main operating hydropower plants of Basochhu, Chhukha, Kurichhu, Tala, and Dagachhu have a total installed capacity of 1,606 megawatts (MW). While the government has declared the goal of reaching a capacity of 10,000 MW by the year 2020, the overall hydropower potential of the Himalayan country is estimated at about 30,000 MW (NEC 2011: 38). However, it seems more likely that a minimum capacity of 5,000 MW could be installed by 2020, half of the initial ambitious target, with the finalisation of the three large-scale hydropower projects of Punatsangchhu I, Punatsangchhu II, and Mangdechhu under construction, together accounting for 2,940 MW, and with the planned 600 MW Kholongchhu power plant (Kuensel 2015d).

The operating hydropower plants not only generate clean electricity for growing domestic demand, but contribute a major share of the total revenue through export of surplus energy to India. With more hydropower plants under construction and in the pipeline, the export of hydroelectricity is expected to be the biggest backbone of Bhutan's economy. However, some reimport of electricity from India is still required in the winter months during times of less energy generation due to low river flows and high domestic consumption (DGPC 2014: 27). In the year 2014, 159 million units (MU) have been imported (NSB 2015: 120).

Moreover, the energy exports earn Indian rupees, a currency in high demand, because ninety percent of imported goods come from the southern neighbour country (NSB 2015: 181) and have to be paid in Indian rupees, as the Bhutanese ngultrum, though at par with the Indian rupee by fixed exchange rate, is a nonconvertible currency. In the year 2014, out of the total electricity generation of 7,164 million units (MU) 5,147 MU have been exported, hence, with a total energy requirement of 2,085 MU domestic consumption has still been low but is constantly increasing with the finalisation of rural electrification programmes and private sector development (NSB 2015: 120). Bhutan follows the practice of India, where electrical energy is expressed in terms of units, using one unit for one kilowatt-hour (kWh) (electrical4u 1). Hence, one million units (MU), as used in Bhutan's statistical reports, is equivalent to one gigawatt-hour (GWh).

Urban and rural households account for ten percent of domestic electricity consumption while around eighty percent of electricity is consumed by the industry (NSB 2015: 121). Fossil fuels imported from India are mainly used for the steadily growing transport sector and industries as well. Though water seems to be an unlimited renewable natural resource the hydropower sector is prone to threats from glacial lake outburst floods, erratic precipitation and stronger seasonal changes in river flows, and increasing sedimentation of rivers (NEC 2011: 8).

Agriculture

Bhutan is a predominantly agricultural society, where rural communities from the subtropical plains in the south to the alpine zones in the north traditionally earn their living mainly from subsistence farming, together with livestock like cattle, horses, and poultry, and yaks at higher altitudes, and often combined with home based small cottage industries. Major crops cultivated are wheat, barley, paddy, maize, buckwheat, and millet (NSB 2015: 86-87). Over the last decade there is an increasing tendency to produce cash crops like apples, oranges, ginger, areca nut, cardamom, chilies, and vegetables not only for the local market but rather for export (NSB 2015: 80).

Agriculture is the single largest sector providing livelihood for about fifty-seven percent of the population while contributing nearly seventeen percent to the country's economy, also supported by government's subsidies for mechanisation of small holder farms (NSB 2015: 80-81). The agricultural area only comprises around three percent of the country's total area, with another four percent area used as meadows (NSB 2015: 99). Although crops can be grown throughout the year, agricultural productivity and yields are too low to meet the food requirements of an increasing population and food imports are required, showing high potential of improvement through better agricultural practices (MoAF 1).

Forestry

Bhutan's forest cover accounts for 70.5 percent of the country (NSB 2015: V). Timber is in high need for the construction sector, housing, furniture production, firewood, fencing, and poles for prayer flags all across the country, providing business for saw mills and timber industry. Besides state owned and commercial forest based industries

the instrument of community forestry on government forest lands entitles communities to manage natural resources and provides access to forest products like timber and fuelwood for local demand (Dorji; Schmidt 2014: 14). As of 2014, 25,663 households were engaged in 600 community forests with a total area of 66,934 hectares (669.3 square kilometres, 258.4 square miles) (GNHC 2015: 5). However, to protect the vast forests the government has enacted a ban on export of raw timber (NEC 2012a: 27).

Additional income can be generated through sale of timber and non-timber forest products, especially medicinal plants. Not for nothing Bhutan sometimes is called 'menjong yul', land of medicinal herbs (Tshewang: 3). Currently, around 300 species of medicinal plants are collected out of more than 1,000 described in the Bhutanese traditional medicine, contributing not only to income for farmers but also to conservation of the plants and their natural environment by recognising their value and sustainable use, to preservation of traditional medical knowledge, to support of free traditional health care services, and to bio discovery research (Wangchuk; Tobgay 2015: 2).

Since the legalisation of its collection in 2003 cordyceps has turned out as major source of income for some mountain rural communities, for instance in the northern district of Gasa, where livelihoods of former poverty stricken highland yak herders substantially have improved through the lucrative trade (Kuensel 2015e). Cordyceps (*Ophiocordyceps sinensis*; Bhutan: yartsa goenbub) is a parasitic caterpillar fungus, which fetches high prices as traditional medicine and natural aphrodisiac either at government controlled auctions or from exporters. A construction boom has been observed in Laya, one of the highest gewogs in Gasa dzongkhag, not only for improved housing but also due to government's regulations that three persons per household are entitled to collect cordyceps, which led to family splitting and building of additional houses (Kuensel 2015e). Layaps (people of Laya), traditionally migrating with their yak herds to lower pastures during cold winter months, also benefit from growing tourism by renting of horses along the popular trekking routes in the northern mountains of Bhutan.

Apart from climate change induced impacts the country's extensive forests and biodiversity also face pressures from rapid urbanisation, infrastructure and industry development, and population growth (NEC 2011: 8). To sustain and increase Bhutan's forest cover mass tree plantation campaigns are launched at different occasions with volunteers planting saplings provided by the government. For instance, 108,000 trees were planted throughout the country in March 2016 in honour of the royal child born on 5 February 2016 (Kuensel 2016e). Or in June 2015 a new Guinness world record was set in planting 49,672 trees in one hour by one hundred men, on twenty-five acres (101,200 square metres) of land at the hillside of Kuenselphodrang in the capital Thimphu (Kuensel 2015f).

6.7. Environment and biodiversity

The high recognition of the value of natural environment and biodiversity and the need for their long-term protection is laid down in Bhutan's first written constitution, the supreme law of the country, adopted on 18 July 2008. The whole article number five of the constitution is about environment and the first section article 5.1 states: "Every Bhutanese is a trustee of the Kingdom's natural resources and environment for the benefit of the present and future generations and it is the fundamental duty of every citizen to contribute to the protection of the natural environment, conservation of the rich biodiversity of Bhutan and prevention of all forms of ecological degradation including noise, visual and physical pollution through the adoption and support of environment friendly practices and policies" (The Constitution of the Kingdom of Bhutan 2008: 11).

With the long-term perspective of preservation the principle of equity between generations has been embedded in the constitution, together with the duty of all citizens to actively protect the environment. This duty again is reflected under article eight about the fundamental duties of all citizens: "A Bhutanese citizen shall have the duty to preserve, protect and respect the environment, culture and heritage of the nation" (The Constitution of the Kingdom of Bhutan 2008: 16).

In the next step, article 5.2 links environmental conservation to socio-economic development and describes the government's responsibility to "(a) Protect, conserve

and improve the pristine environment and safeguard the biodiversity of the country; (b) Prevent pollution and ecological degradation; (c) Secure ecologically balanced sustainable development while promoting justifiable economic and social development; and (d) Ensure a safe and healthy environment” (The Constitution of the Kingdom of Bhutan 2008: 11). In the overall legal framework of Bhutan sustainable development is conceptualised as a balance between environmental protection and socio-economic development to be secured by the state. And writing these principles down in the constitution also gives citizens the legal right to take violations by the government to the court.

Finally, article 5.3 gives the precise mandate to the government to “ensure that, in order to conserve the country’s natural resources and to prevent degradation of the ecosystem, a minimum of sixty percent of Bhutan’s total land shall be maintained under forest cover for all time” (The Constitution of the Kingdom of Bhutan 2008: 12). According to the Statistical Yearbook of Bhutan 2015 the forest cover amounts to 70.5 percent of the country (NSB 2015: V). However, the condition of keeping sixty percent of the country forested was already stipulated more than thirty years earlier in the National Forest Policy 1974, reflecting the high significance of forests in Bhutan during recent history (Phuntsho 2011: 1). Reconfirmed now at the supreme legal level, this can be considered as a unique constitutional provision to qualitatively and quantitatively protect natural resources against potential exploitation. And in the era of climate change, a country preserving forest cover on the majority of its area is reliably contributing to carbon sequestration.

Aside from protection of environment as the central goal there are multifaceted benefits involved with the preservation of forests in the mountainous terrain. As densely wooded slopes help to diminish landslides during the heavy rainfalls of the annual monsoon season, protection of forests is also understood as prevention of destruction of human settlements, infrastructure, and agricultural land (Tobgye 2014: 124). Securing the forest cover further contributes to protect catchment areas of spring water sources essential for communities, livestock, and agriculture. Furthermore, the rivers flowing down from the northern mountains to the southern plains enable the generation of hydroelectricity for domestic demand and export.

Water resource is considered the main asset of Bhutan to generate national income and secure the development of the country (Tobgye 2014: 124). Thus, in the constitution, environmental conservation is also understood in the context of safeguarding major economic interests of the nation while preventing exploitation for short time revenue.

Consequently, as the preservation of environment and the rich biodiversity of the country is laid down as a constitutional principle of “shared public and private responsibility” (Tobgye 2014: 125), environment, again in conjunction with social and economic development, is one topic of political decentralisation. Under the chapter about local governments article 22.1 states that the purpose of elected local governments is “to facilitate the direct participation of the people in the development and management of their own social, economic and environmental well-being” (The Constitution of the Kingdom of Bhutan 2008: 42). With these provisions on environment in the new constitution of 2008 Bhutan obviously has chosen a path “protecting its limited resources, without compromising on the development of the country” (Tobgye 2014: 124).

High awareness of the value of environment also is stated by the Chief Justice of the Supreme Court of Bhutan, who plans to establish a green bench for environmental issues at the High Court. Public interest litigation in environmental matters shall strengthen civil society and provide people with access to justice on the government’s accountability for the implementation of environmental laws and regulations (Personal communication Chief Justice 2015).

In the triangular context of forest conservation, socio-economic development, and political decentralisation community forestry plays a significant role in Bhutan. As forest land is owned by the government the instrument of community forestry gives rural communities rights and responsibilities for the use and management of designated forest areas (Dorji; Schmidt 2014: 6). With this collaborative institutional approach rural communities become involved in managing the natural resources in their surroundings in a sustainable way. While meeting their local demand for timber and fuelwood communities can also generate income through sale of timber and non-wood forest products.

At a national and global perspective and in the context of climate change, community forestry is considered “exemplary of Bhutan’s national vision of placing sustainable management and conservation of natural resources at the forefront of development. It fully recognises the value of our natural resources and the importance of maintaining environmental integrity not only for national benefit but also for the global community as a repository of globally significant biodiversity, and as a carbon sink” (Phuntsho et al. 2011: i). Local research on practises and experiences of community forestry management groups in the country has revealed positive impacts like improved forest cover, and prevention of resource degradation (Samdrup 2011: 6). Furthermore, while poor members have benefited from the access to forest resources, communities also are interested in expanding their activities from subsistence use of forest products towards establishing home or small enterprise based commercialisation of forest resources, yet facing lack of funds and knowledge (Samdrup 2011: 5). The study states the need for capacity building on processing and marketing, and provision of loan schemes by the government in order to support the setup of small community forestry enterprises (Samdrup 2011: 10).

However, a 2014 review of community forestry in Bhutan identifies scope for improvement in the areas of regulatory framework and institutional collaboration, closer linkage to local governments, management skills of community forest groups, and resource mapping and boundary demarcation of the forest areas, and recommends clarification on customary rights of households and communities for grazing of livestock (tsamdro) and leaf litter collection (sokshing), and utilisation of boulders and sand from community forest areas (Dorji; Schmidt 2014: 21-28).

Putting the commitment to conserve environment and biodiversity into practise, Bhutan has established ten protected areas as national parks and wildlife sanctuaries with a total area of 16,396 square kilometres (6,331 square miles), covering almost forty-three percent of the country and home to a rich variety of plants, mammals, and birds (BTFEC 1).

Among the endangered species, the takin, a rare kind of mammal with curved horns, large nose, thick neck and short muscular legs, is considered the national animal of Bhutan (TCB 7). The legend tells that Bhutan’s favourite Buddhist saint Drukpa Kuenley

(1455-1529), called the divine madman due to his unorthodox preaching practise, created this unique animal during a gathering of his devotees expecting him to exercise his magical power. Drukpa Kuenley requested the villagers to serve him a cow and a goat for lunch and after having finished them off, he fixed the head of the goat to the bones of the cow, vitalised the new animal, and the takin was created, grazing in the mountain meadows to this day (Ugyen 2007). Aside from the takin preserve in upper Motithang in the northwestern hilly outskirts of the capital Thimphu, wild takin herds mostly live in the Jigme Dorji National Park, Bhutan's second largest protected area covering 4,316 square kilometres (1,666 square miles) with an altitude range up to above 7,000 metres (22,966 feet) (BTFEC 1). The major part of the park's protected area lies within Gasa dzongkhag in northern Bhutan.

Bhutan's efforts for environment conservation also are visible in the country's legislations such as the Environmental Assessment Act 2000, National Environment Protection Act 2007, Waste Prevention and Management Act 2009, and Water Act 2011 (GNHC 2013a: 235).

6.8. Human wildlife conflict

Biodiversity protection sometimes is posing problems for farmers facing loss of livestock and crop damage by wildlife. Especially affected are villages inside or in close vicinity to protected parks and forests. Key predators are tiger and snow leopard, followed by common leopard and black bear, killing livestock like cattle and horses, while crops are mainly damaged by wild pigs and Sambar deer (MoAF 2). Often considered a role model for nature conservation the country increasingly is rising to the challenge how to balance environmental protection and viable rural livelihoods based on scarce agricultural land. Compensation for livestock predation by wild animals was introduced by the Ministry of Agriculture and Forests, initially to prevent farmers from retaliatory killing of wildlife and further extended to the more frequent incidents of damaged fields. The fund scheme provides seed money for gewogs requiring establishment of local conservation committees for compensation fund management (MoAF 2). Additionally, the ministry initiated countrywide assessments of human wildlife conflict situation and studies on wildlife population, migration patterns, and reasons for intruding into farmland (Kuensel 2016f).

Agriculture records from July 2013 to June 2015 report devastated farmland of 8,058 acres (32.61 square kilometres) by wild animals across Bhutan causing a total crop loss of 7,542 tonnes, out of which 1,725 tonnes were paddy and 1,070 tonnes potatoes (Kuensel 2016f). So far electric fencing has proved to be the most effective measure to protect fields, though problems of maintenance on the part of local communities have been reported, besides budgetary constraints. Since 2013, 1,236 kilometres (768 miles) of electric fences have been erected protecting 7,698 acres (31.15 square kilometres) of farmland belonging to 6,638 rural households. While the government plans to accelerate electric fencing by providing resources and technical assistance local communities need to contribute labour and maintenance of fences to ensure sustainability (Kuensel 2016g).

In the subtropical southern parts of Bhutan additional problems arise through frequent attacks of roaming herds of wild Asian elephants rampaging sheds and damaging fields. In 2016 the agriculture ministry has initiated a countrywide survey along the southern belt to determine the elephant population, study migration patterns and to analyse loss of habitat due to developmental activities like road construction in order to formulate adequate conservation policies and to better support farmers to protect their crops from damage (Kuensel 2016h).

6.9. Gross national happiness

The high recognition of the value of natural environment and biodiversity is embedded in the guiding concept for the country's holistic development, the concept of gross national happiness (GNH). The idea of GNH as a better suitable measurement than a gross domestic product (GDP) for the development and living standard of Bhutan was introduced by the fourth king Jigme Singye Wangchuck in the 1970s, implying "that sustainable development should take a holistic approach towards notions of progress and give equal importance to non-economic aspects of wellbeing" (CBS 1). The concept is based on the four pillars of good governance, sustainable socio-economic development, cultural preservation, and environmental conservation (CBS 1).

To better reflect different "components of wellbeing" (CBS 1) in the lives of Bhutanese people, these four pillars have been divided into the nine equally weighted GNH

domains of psychological well-being, health, time use, education, cultural diversity and resilience, community vitality, good governance, ecological diversity and resilience, and living standards; and differently weighted indicators within these nine domains enable the measurement of the level of achieved sufficiency (CBS 2015: 3). In a nutshell, gross national happiness recognises that “material well-being is important but it is also important to enjoy sufficient well-being in things like community, culture, governance, knowledge and wisdom, health, spirituality and psychological welfare, a balanced use of time, and harmony with the environment” (CBS 2015: 2). This essential role of gross national happiness as core principle for holistic development has been reinforced in the nation’s first constitution of 2008 in article nine on the principles of state policy: “The State shall strive to promote those conditions that will enable the pursuit of Gross National Happiness” (The Constitution of the Kingdom of Bhutan 2008: 18).

In 2015 a countrywide GNH survey was carried out by the Centre for Bhutan Studies and GNH Research (CBS). CBS engaged sixty-six trained university graduates organised in six survey teams who travelled between January and May 2015 across all twenty dzongkhags and conducted interviews with 7,153 citizens aged between fifteen and ninety-six years (CBS 2015: 4). The questionnaire covered all nine GNH domains and a GNH profile for each interviewed person was created. Based on all profiles the national GNH index was measured, ranging from zero to one (CBS 2015: 2; CBS 1). The GNH index 2015 is 0.756, which shows a slight improvement from the last survey of the year 2010 with an index of 0.743 (CBS 2015: 1).

According to the scores of sufficiency achieved in the nine domains of GNH the interviewed people were ranked in four categories: as ‘deeply happy’ were 8.4 percent considered with a score range from seventy-seven to one hundred percent; ‘extensively happy’ were thirty-five percent scoring sixty-six to seventy-six percent; ‘narrowly happy’ were 47.9 percent with a score range from fifty to sixty-five percent; and 8.8 percent were identified as ‘unhappy’ scoring zero to forty-nine percent (CBS 2015: 1). (As these figures provided by CBS add up to 100.1 percent, 0.1 percent need to be deducted either from the category ‘narrowly happy’ or ‘unhappy’ according to the total figure of 56.6 percent given as summary for these two categories in another

part of the report, whereas 43.4 percent are reported as 'deeply happy' or 'extensively happy' (CBS 2015: 7)). Overall the number of people being 'extensively or deeply happy' has increased from 40.9 percent in 2010 to 43.4 percent in 2015 (CBS 2015: 2). Nevertheless, the majority of people of 56.6 percent obviously still needs to reach a more content state of life according to the GNH index.

Showing "a self-portrait of a society in flux" (CBS 2015: 2) the GNH index indicates that fifty-one percent of men are happy compared with thirty-nine percent of women, but with the GNH of women reportedly increasing faster than men's GNH in the period from 2010 to 2015 gender inequality seems to get reduced (CBS 2015: 5). At the same time, fifty-five percent of urban people are described happy compared with thirty-eight percent living in rural areas with a faster increasing urban happiness index indicating a growing disparity between urban and rural Bhutan (CBS 2015: 5).

In the cultural domain, stable indicators are reported for artisan skills and practise of native languages, and participation in cultural activities has increased for fourteen percent of people, whereas the importance of driglam namzha has decreased for seventeen percent of people (CBS 2015: 6). Driglam namzha is commonly understood as traditional Bhutanese code of etiquette. The term driglam consists of 'drig' for order, conformity, uniformity, and 'lam' for way, path, and namzha means concept or system (Phuntsho 2004: 572). It dates back to the seventeenth century when Ngawang Namgyel introduced a formal code of practise for religious and administrative institutions in Bhutan derived from Tibetan Buddhist monks and elites. Later it became strongly linked to the concept of Bhutanese national identity and is politically enforced since then through various legislations, for instance to wear traditional Bhutanese dress at formal occasions (Phuntsho 2004: 572-573).

In the domain of ecology, satisfaction with ecological issues and dealing with wildlife damage has improved, especially for rural communities (CBS 2015: 6). The most significant decrease is observed in the domain of good governance, showing a sharp drop of forty-six percent less people being satisfied "with government performance in employment, equality, education, health, anti-corruption, environment and culture" (CBS 2015: 6). As the previous survey in 2010 took place just two years after the first election of parliament people might have been more optimistic at that time, "as

people's aspirations of government under a democratic system evolved" (CBS 2015: 6). However, also the indicators for fundamental rights and political participation have decreased since then, noteworthy for further democratic development. At the same time, in the same domain of governance, the indicator for service delivery increased reflecting visible improvements in twelve dzongkhags in the areas of "health care, waste disposal method, access to electricity, water supply and water quality" (CBS 2015: 6).

Finally, sufficiency in the domain of living standards increased for all areas of housing, assets, and household income (CBS 2015: 6). With this GNH index developed for quantitative surveys and information to policy makers, gross national happiness has "emerged as a development philosophy that shapes government policies and programmes" (CBS 2015: 5).

7. Climate change in Bhutan

7.1. Observations

According to the identified climate change commonalities in the Himalayas, Bhutan experiences faster melting of snow and mountain glaciers which increases the number and volume of glacial lakes dammed by moraine walls, thus raising the risk of glacial lake outburst floods (GLOFs). Out of the 2,674 glacial lakes of Bhutan twenty-five are considered potentially dangerous posing the threat of rising water levels, eroding moraine dams, and downstream floods (NEC 2011: 8). Bhutan already has experienced GLOFs in the years 1957, 1960, 1968 and 1994 with casualties and damages in the downstream valleys (Rinchen 2008).

Among the total of 885 glaciers mapped in Bhutan in 2010 fragmentation of shrinking glaciers led to an increasing number of smaller glaciers, while the overall glacier area decreased by twenty-three percent over the last three decades from 1980 to 2010 (Bajracharya et al. 2014: 159, 165). Based on satellite images from the least snow cover period between September and November changes in the altitude of the snowline in Bhutan's glaciers (equilibrium-line altitude, ELA) were measured. The study results show that the glacier snowline shifted 180 metres (591 feet) upward on average in the time period between 1980 and 2010 (Bajracharya et al. 2014: 160, 165).

Additionally to the significant threat of GLOFs for communities in the mountain valleys and downstream river basins general observations of current climate change vulnerabilities in Bhutan include land degradation due to flash floods, landslides and erosions caused by high intensity rainfall and cyclones; droughts caused by drying water sources due to rising temperatures, and longer intervals between rainfalls; increasing frequency and scale of wind-, hail- and thunderstorms caused by changing weather patterns; and spread of agricultural pests and diseases (Khandu 2014: 14-15).

Compared to data of the historical period from 1980 to 2009, projections indicate an increase of the mean annual temperature by 0.8 to 1.0 degree Celsius (°C) for the period of 2010 to 2039, and a stronger increase by 2.0 to 2.4 °C from 2040 to 2069, with summer temperatures rising by 0.8 °C in 2010 to 2039 and by 2.1 °C for 2040 to 2069, while during winter periods higher increase is expected of 1.2 °C for 2010 to 2039, and even 2.8 °C for the period of 2040 to 2069 (NEC 2011: 7). At the same time, projections of the mean annual precipitation indicate an increase of ten percent for the period 2010 to 2039, and twenty percent for 2040 to 2069, showing trends of slightly dryer winter seasons and significantly more rainfall during summer monsoon seasons (NEC 2011: 7). Less precipitation in winter and more extreme monsoon rainfall will have impacts on water availability for households, agricultural irrigation, and hydropower plants.

7.2. Sector vulnerability assessment

A more detailed sector vulnerability assessment by the National Environment Commission (NEC) presents anticipated climate change risks for the country. The three sectors of agriculture, forestry, and water are strongly interlinked and essential for livelihoods and development of rural communities.

For the agriculture sector identified risks include deteriorated crop yield quality or loss due to untimely heavy rainfall and hailstorms, loss of soil fertility through erosion, and loss of arable land caused by flash floods and landslides. On the other side, shifting cultivation zones to higher altitudes due to increasing temperatures may also have positive impacts creating new opportunities for rural mountain communities, provided that sufficient irrigation will be possible and that extreme weather events and

potentially increasing pestilence of invasive pests and diseases affecting both crops and livestock will not outweigh the benefits for rural livelihoods (NEC 2009: 21, 23).

For the forestry sector risks of more frequent forest fires due to draughts in combination with lightning strikes were identified, together with general impacts of warmer winters on reduced snow cover and therefore less available melt water for the growing season resulting in declining forests. Rising temperatures also will favour expansion of invasive weedy species competing with cold adapted high elevation forest species. Additionally, climate induced environmental and temperature changes will affect migratory patterns of wildlife and possibly increase vector borne wildlife diseases (NEC 2009: 21-22).

Regarding the water sector, Bhutan's springs, rivers, and ponds are mainly snow and rain fed, thus depending on glaciers, snow cover, and seasonal rainfall, as well as on forests. Melting of debris covered glaciers, floods, and landslides also increase sedimentation of rivers, affecting water reservoirs and irrigation systems for agriculture. Apart from climate change impacts on river flows upstream human development activities in catchment areas also can cause increased sedimentation of rivers. Additionally, reduced average river flows combined with the risk of floods and sedimentation will have negative impacts on urban water supply and hydropower generation. Deterioration of drinking water quality or even loss of safe drinking water resources again increase the risk of proliferation of water borne diseases (NEC 2009: 22-24). The vulnerability assessment shows that livelihoods of people are directly affected by climate change.

7.3. Commitment to carbon neutrality

In the face of climate change Bhutan's government has announced that the country will remain carbon neutral for all times. In 2009 at the UNFCCC conference (COP 15) in Copenhagen, Denmark, Bhutan's delegates presented a document entitled 'Declaration of the Kingdom of Bhutan - The Land of Gross National Happiness to Save our Planet', stipulating the country's role as a net sink for greenhouse gases (GNHC 2013a: 235). This commitment was reiterated in 2015 at the UNFCCC conference (COP 21) in Paris, France. Remaining carbon neutral means that carbon emissions from

energy consumption “are either avoided, reduced or offset, to a net result of zero emissions” (GNHC 2011a: 80). Hence, Bhutan will balance the amount of carbon dioxide released into the atmosphere mainly from burning fossil fuels by transport and industry, but also including emissions from agriculture, with the sequestration of carbon dioxide by the country’s forests, and also with the export of renewable energy generated from hydropower which offsets fossil fuel use in the importing country.

Beyond this commitment to carbon neutrality, Bhutan’s prime minister Tshering Tobgay in his talk at the TED conference in February 2016 in Canada pointed out that the country actually is carbon negative (Tobgay 2016). According to his explanation, Bhutan generates 2.2 million tonnes of carbon dioxide per year and its forests sequester more than three times of this amount, making Bhutan a net carbon sink for about four million tonnes of carbon dioxide (CO₂). Furthermore, the country’s export of hydroelectricity offsets about six million tonnes CO₂ in neighbouring India, an amount which is expected to rise to seventeen million tonnes CO₂ by 2020 based on the ongoing construction of additional hydropower plants in Bhutan. While reporting this double function of the small Himalayan state to serve as a net carbon sink inside the country and to offset carbon dioxide across its borders by exporting hydroelectricity Tshering Tobgay highlighted that “Bhutan has done nothing to contribute to global warming” (Tobgay 2016). While greenhouse gas emissions are only about one third of the sequestration capacity of Bhutan’s forests, however, a growing population together with socio-economic development, transport, and industry is leading to further growing emissions.

In his earlier State of the Nation Report 2015, presented as report on the Tsa-Wa-Sum, meaning king, country and people (Tobgay 2015: 3), the prime minister called climate change “one of the major drivers of change on the state of the natural environment in Bhutan” (Tobgay 2015: 44). While “Bhutan is considered a role model in conservation” (Tobgay 2015: 44) especially in the context of climate change and global warming, the government in 2015 embarked the Bhutan for Life initiative to “ensure sustainable financing for the conservation of Bhutan’s protected areas and biological corridors” (Tobgay 2015: 45). The fund’s goal was set to raise forty-five million US dollars by 2016 to be used “for the conservation of 6 million acres of forests and other natural

habitats, and sustainable economic livelihood of communities in these areas” (Tobgay 2015: 46). This financial mechanism is designed as a transition fund for the period of fifteen years to enable the government to come up with its own funding for the time afterwards (Tobgay 2016).

8. Development planning in the context of climate change in Bhutan

8.1. Mainstreaming of climate change

Climate change is one of the areas to be mainstreamed into national and local development planning. This is facilitated by the establishment of a multi-agency mainstreaming reference group as per the prime minister’s executive order from 2013, stipulating five areas of mainstreaming, namely gender, environment, climate, disaster, and poverty (GECDP) (Thinley 2013: 1). This multi-sectoral technical group is meant to advise on coordination of more inclusive development planning processes across the main sectors while integrating both opportunities and risks of the cross cutting issues of gender, environment protection, climate change, disaster risk reduction, and poverty alleviation.

To further support decentralised integrated development planning local GECDP mainstreaming reference groups are going to be established in all twenty dzongkhags of the country. Chaired by the dzongdag (governor) and coordinated by the dzongrab (deputy governor), these groups include the dzongkhag officers for planning, forestry, livestock, agriculture, environment, education, and health, thus facilitating cross-sectoral mainstreaming and planning, capacity building, and review of local development plans (Personal communication DLG 2015). Nevertheless, further capacity building seems appropriate for planning and sector officials especially at dzongkhag and gewog level on integrating climate change together with the cross cutting issues of gender, environment, disaster management, and poverty into local development planning.

8.2. Institutional setup

All institutions need to consider climate change among the other cross cutting issues in their policies and plans. Some key institutions relevant for development planning in the context of climate change are highlighted below.

Gross National Happiness Commission

The government's focal agency for development planning is the Gross National Happiness Commission (GNHC) mandated to "ensure that GNH is mainstreamed into the planning, policy making and implementation process" (GNHC 1). Hence, all draft policies and plans of government agencies have to be reviewed by the commission and evaluated on their relevance for gross national happiness before being endorsed. GNHC plays a key role in developing the five-year plans for national and local development by formulating national priorities, goals and targets, and finally has to approve the allocated resources for central and local government. Furthermore, GNHC interacts with international donor agencies and coordinates financial development assistance in accordance with the targets of the five-year plans (GNHC 1).

National Environment Commission

As a national multi-sectoral agency the National Environment Commission (NEC) has the mandate to decide and coordinate "on all the matters relating to the protection, conservation and improvement of the natural environment" (NEC 1). NEC's mission is to "protect the environment in the widest sense of the term for the well-being of all future generations of people and other sentient beings by preserving and managing the natural resources" (NEC 1). NEC is involved in developing guidelines and procedures to mainstream environmental issues into policies and programmes (NEC 2009: 12). NEC also acts as high level climate change committee with the NEC secretariat as the national focal agency for climate change. Furthermore, the commission is the designated national authority for the Clean Development Mechanism under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC) (NEC 2009: 25). Together with a multi-sectoral technical committee on climate change formed in 2009 as a national level forum NEC is

supposed to play the lead role for the coordination of climate change issues in Bhutan (NEC 2011: 21; NEC 2015: 7).

Ministry of Agriculture and Forests

The sectors of agriculture, forests, and water resources are predominantly affected by climate change. The Ministry of Agriculture and Forests (MoAF) is the line agency of the Royal Government of Bhutan for developing agriculture policies and strategies and supporting local governments. Economic activities of rural communities are based on natural resources with interdependence of agriculture, livestock, and forests. The ministry's main objectives are to ensure sustainable rural livelihoods, support protection and sustainable management of forest and water resources, promote sustainable use of agriculture and pasture land, and to enhance food security (MoAF 3). Key roles for rural development, food security, and forest protection play the Department of Agriculture, Department of Livestock, and Department of Forests and Park Services.

Council for Renewable Natural Resources Research of Bhutan

Under the Ministry of Agriculture and Forests, the Council for Renewable Natural Resources Research of Bhutan (CoRRB), until its dissolution in 2016, was responsible to coordinate and monitor research and policies on sustainable management of renewable natural resources (RNR). Innovative research needs to support “social, economic and environmental sustainability through development of science and technology” (MoAF 4). After CoRRB has been dissolved in March 2016 as result of an organisational development exercise carried out by the Royal Civil Service Commission (RCSC) research activities have been taken over by the Department of Agriculture (Personal communication MoAF 2016).

National Biodiversity Centre

The National Biodiversity Centre (NBC) was established in 1998 under the Ministry of Agriculture and Forests to coordinate biodiversity conservation and sustainable use of the country's biological resources (NBC 1). The centre is part of the consortium operating the Bhutan Biodiversity Portal providing public information and data on biodiversity (NBC 2). NBC operates the National Herbarium and the Royal Botanical

Garden in Serbithang, Thimphu, and takes care of plant and animal genetic resources through the National Gene Bank conserving crop seeds and semen of local livestock breeds as well as through on-farm conservation to maintain relevant native species in their natural environment and on agricultural land, thus contributing to food security (NBC 3).

Department of Local Governance

Under the Ministry of Home and Cultural Affairs, the Department of Local Governance (DLG) supports the decentralisation process and strengthens efficient, transparent and accountable local governments. DLG is responsible to facilitate coordination between local governments and central government agencies, and to enhance capacities of local functionaries with the overall mission to ensure service delivery to the people, and to strengthen democratisation through direct participation of the people (DLG 1).

Department of Disaster Management

Under the Ministry of Home and Cultural Affairs, the Department of Disaster Management (DDM) is responsible to coordinate disaster risk management in the country. For this purpose DDM strives to assist local governments and institutions to prepare disaster management plans, raise awareness on risks and prevention, build capacities in disaster management, and provide relief grants to people affected by disasters to support poverty alleviation. Furthermore, the department develops guidelines and publishes data and information on disasters (DDM 1).

Ministry of Economic Affairs

Promoting a green and self-reliant economy sustained by a knowledge society, enabled by information technologies and guided by the philosophy of gross national happiness, is the vision statement of the Ministry of Economic Affairs, the government's line agency for developing policies and strategies and supporting public and private sector development to create an enabling environment for sustainable economic growth (MoEA 1; MoEA 2). Sustainable socio-economic development is one of the four pillars of gross national happiness (GNH), besides good governance, cultural preservation, and environmental conservation (CBS 1). To achieve the government's goal of economic self-reliance by the year 2020 the ministry promotes diversification and

productivity enhancement of Bhutan's economy while keeping in line with the values of GNH (RGoB 2010: 5).

Guided by the Economic Development Policy of the Kingdom of Bhutan 2010 to facilitate environment friendly growth in industry and private sector development, besides the large hydropower projects as main energy generator, the "promotion of green technology, micro-hydro projects, solar, wind, biomass and energy efficiency" (RGoB 2010: 5) shall further contribute to climate change mitigation efforts in reducing greenhouse gas emissions. While promoting the Himalayan country itself as a brand for quality products and services in the context of successful environment conservation, protection of biodiversity and genetic resources together with consideration of indigenous knowledge also shall contribute in developing the 'Brand Bhutan' (RGoB 2010: 5-6).

Department of Geology and Mines

Established in 1981 under the Ministry of Economic Affairs, the Department of Geology and Mines (DGM) with its divisions for geological survey, glaciology, seismology, and mining is mandated to manage geo-scientific research, natural mineral resources, and mining activities in the country (DGM 1). Due to lack of capacities and expertise geological mapping and mineral exploration earlier was conducted by the Geological Survey of India (DGM 2).

Linked to sustainable development planning is DGM's role for guiding utilisation of Bhutan's mineral resources while minimising the risk potential for health and environment, and for promoting research on and mitigation of climate change induced hazards like landslides and GLOFs. Additionally, in view of devastating earthquakes in the Himalayan region, improving earthquake resilience through implementation of earthquake-proof construction codes and increase of community preparedness are of high importance (DGM 2).

Department of Renewable Energy

Established in 2011 under the Ministry of Economic Affairs, the Department of Renewable Energy (DRE) is mandated to research and explore renewable energy sources and appropriate and affordable technologies apart from large hydropower

plants. In view of a rising domestic power demand and the country's huge reliance on hydropower, and considering concerns of climate change, DRE's goal is to complement the country's energy supply and enhance energy security, particularly during winter seasons when hydropower generation is reduced due to low river flows (DRE 1).

The department is the designated focal agency for implementing the Alternative Renewable Energy Policy adopted in 2013 to promote a diversified mix of renewable energy sources and to strengthen energy security together with sustainable socio-economic development and environment protection, while contributing to mitigate climate change through reduction of greenhouse gas emissions from fossil fuel use (RGoB 2013: 5).

Druk Holding and Investments

Established through a royal charter by the fifth king in 2007 Druk Holding and Investments (DHI) functions as the management body for the government's commercial investments aiming for the creation of a strong economic base for a vibrant democracy and for acceleration of socio-economic development for the benefit of the people (DHI 2008: 5). As the country's largest holding company with shares of twenty enterprises in the sectors of manufacturing, energy and natural resources, financial services, real estate and construction, communications and transportation, and trading DHI contributes to the national budget by paying annual dividends to the finance ministry (DHI 1; DHI 2008: 6).

Furthermore, DHI can play a significant role in economic development in terms of innovation and competitiveness, having influence on technologies and energy use of industries important for mitigation of greenhouse gases. DHI's corporate profile also states responsibility to uphold the values of gross national happiness, including environment protection and public accountability (DHI 2), thus, enhanced interaction with climate sensitive economic development planning can be established.

Local governments

At the level of local governments highest decision-making bodies are established in the twenty dzongkhags, called dzongkhag tshogdu (district assembly), in the 205 gewogs, called gewog tshogde (county council), and in the cities as thromde tshogde (city

council), all of them mandated to promote, monitor and evaluate local development planning in cooperation with the central government (The Local Government Act of Bhutan 2009: 3, 14, 16, 19).

8.3. Multilateral agreements related to environment and climate change

United Nations Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) was ratified by Bhutan in 1995. Subsequently, as reporting obligation to UNFCCC, the Initial National Communication (INC) was submitted in 2000. The INC covered a first national assessment on climate change vulnerabilities and adaptation, a preliminary inventory on greenhouse gas emissions, and policies, education and research on climate change (NEC 2009: 17).

After a three-year consultative process with various stakeholders the Second National Communication (SNC) was submitted to UNFCCC in 2011. This more comprehensive report on the country's circumstances related to climate change included a more detailed greenhouse gas inventory, mitigation measures with the sequestration capacity of forests and the planned expansion of installed hydropower capacity to 10,000 megawatts by 2020 as the most significant ones, besides mitigation options in agriculture, transport, industry, and waste management, and an assessment of vulnerabilities and adaptation measures across the main sectors with identified adaptation priorities (NEC 2011: 5-10).

Kyoto Protocol

The Kyoto Protocol for implementation of UNFCCC's goal to reduce greenhouse gas concentrations in the atmosphere by cutting anthropogenic emissions was ratified by Bhutan in 2002 (NEC 2009: 17). Adopted in 2001 in Kyoto, Japan, the Kyoto Protocol had binding targets for industrialised nations to reduce their greenhouse gas emissions. More important for Bhutan, the protocol introduced the Clean Development Mechanism (CDM) as market based mechanism for developing countries to implement projects for reducing emissions while earning carbon credits. These credits then can be sold to industrialised countries assisting them to fulfil their own obligations for emissions reduction (NEC 2).

Under the CDM Bhutan implemented the Chendebji micro hydropower station with seventy kilowatts as successful pilot project; registered the 126 megawatts (MW) Dagachhu hydropower project, completed with technical assistance from Austria in 2015, as first cross border CDM project for exporting clean hydroelectricity to India; and registered the large-scale 1,200 MW Punatsangchhu I hydropower plant under construction in 2014 (Khandu 2014: 9).

Convention on Biological Diversity

In the late nineties, biological diversity increasingly was recognised in United Nation's organisations as crucial for socio-economic development, as incremental threats of ecosystems damage and extinction of species became more obvious. Promoting conservation and sustainable use of biodiversity and equitable sharing of benefits of genetic resources are the main objectives of the Convention on Biological Diversity, adopted in 1992 at the United Nations Conference on Environment and Development at Rio de Janeiro, Brazil, the so called Rio Earth Summit. Bhutan ratified the convention in 1995 (CBD 1; CBD 2).

Convention on International Trade in Endangered Species of Wild Fauna and Flora

In view of an international trade of wildlife plant and animal specimens worth billions of US dollars the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is aiming for regulating international trade while preventing wildlife species from over-exploitation and threats to their survival. The convention was ratified by Bhutan in 2002 (CITES 1; CITES 2).

International Treaty on Plant Genetic Resources for Food and Agriculture

Supporting research on climate change adaptation in agriculture and facilitating exchange of seeds of food crops are goals of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), approved in 2001. In cooperation with the member countries a genepool with 1.6 million samples of plant genetic resources for farmers and scientists was established, thus supporting agricultural biodiversity and food security. The treaty promotes exchange of information and technologies, capacity building, and financial benefits for smallholder farmers. Bhutan ratified the treaty in 2003 (ITPGRFA 1; ITPGRFA 2).

United Nations Convention to Combat Desertification

Initiated in 1992 at the Rio Earth Summit and adopted in 1994, the United Nations Convention to Combat Desertification (UNCCD) is the legal agreement for prevention of land degradation and desertification and for drought mitigation, linked to sustainable land management, protection of ecosystems, and poverty reduction. Specific target areas of the convention are dry lands prone to droughts, where soil productivity needs to be maintained and livelihoods of people improved. Bhutan ratified the convention in 2003 (UNCCD 1; UNCCD 2).

Ministerial declaration for the Bhutan Climate Summit for A Living Himalayas

At the Climate Summit for A Living Himalayas held in November 2011 in Thimphu, Bhutan, the four regional countries Bangladesh, Bhutan, India, and Nepal signed a ministerial declaration on ensuring energy security and promoting alternative technologies, securing the natural freshwater systems, ensuring food security, and securing biodiversity. For this purpose, the countries adopted a framework on regional cooperation to strengthen resilience to climate change in the watersheds south of the Eastern Himalayas (Climate Summit Declaration 2011a: 3; 2011b).

2030 Agenda for Sustainable Development

Proclaimed by the United Nations (UN) and committed by all member states for the period from 2000 to 2015 the Millennium Development Goals (MDGs) guided international development activities mainly in reducing extreme poverty by half, improving health, promoting gender equality, achieving global primary education, and ensuring environmental sustainability (UN 1). Though reducing loss of natural resources and biodiversity was included under goal number seven to ensure environmental sustainability, and also the increase of global emissions of carbon dioxide by more than fifty percent between 1990 and 2012 was mentioned, there was no further reference to climate change (UN 2).

Building on the achievements of the Millennium Development Goals and aiming for the post 2015 development agenda, the Sustainable Development Goals (SDGs) were established by the United Nations general assembly on 25 September 2015 and came into force on 1 January 2016. Under the 2030 Agenda for Sustainable Development the

seventeen SDGs constitute a broad fifteen years framework for all member states to end poverty, fight inequalities, achieve economic growth together with education, health, and social protection, and to address environmental protection and climate change (UN 3). With this development agenda, Bhutan, UN member since 21 September 1971 (UN 4), together with all UN member states recognises the threat of climate change to undermine sustainable development and expresses determination “to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations” (UN 2015: 2).

While climate change is mentioned under goal number two to end hunger and achieve food security as one of the targets for 2030 to strengthen capacity for climate change adaptation (UN 2015: 15), and under goal number eleven for building resilient cities and settlements as one of the targets to be achieved by 2020 to implement mitigation and adaptation to climate change for a substantially increased number of cities (UN 2015: 22), the Sustainable Development Goal number thirteen entirely is dedicated to urgent action against climate change and its adverse impacts (UN 2015: 23). The identified targets under SDG thirteen are to strengthen climate change resilience and adaptive capacity in all countries; to integrate climate change activities into national policies and planning; to improve awareness and knowledge on climate change mitigation and adaptation; to mobilise committed financing for the Green Climate Fund by UNFCCC developed country members; and to raise capacities for climate change planning in least developed countries (UN 2015: 23).

The UN 2030 Agenda for Sustainable Development explicitly refers to the United Nations Framework Convention on Climate Change (UNFCCC) as the primary international forum for climate change (UN 2015: 8). Three months later in December 2015 the UNFCCC Climate Change Conference adopted the new international Paris Agreement on Climate Change.

Paris Agreement on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP 21) took place in Paris, France, in December 2015 and successfully

adopted the Paris Agreement on Climate Change with the goal to keep global warming “well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change” (UNFCCC 2015a: 22).

Prior to the climate conference Bhutan delivered its Intended Nationally Determined Contribution (INDC) to UNFCCC on 30 September 2015 to report the planned voluntary activities under the upcoming climate agreement, striving for future synergies in planning and implementation of mitigation and adaptation actions across sectors, between national and local planning, and also with actions under ratified multilateral environmental agreements. Bhutan reported its intention to develop low emission strategies, while reconfirming the political commitment to remain carbon neutral due to the country’s large forests serving as carbon sink (NEC 2015: 1, 7-8). Bhutan became a signatory to the 2015 Paris Agreement on Climate Change at the signing ceremony at the United Nations Headquarters in New York on 22 April 2016, when 175 countries signed the document (Kuensel 2016a).

8.4. Review of national laws, policies and programmes in relation to climate change

Though environmental conservation has been a long-standing major concern of Bhutan’s government and several bills on environment have been passed at an early stage such as the Forest and Nature Conservation Act 1995, the Mines and Minerals Act 1995, and the Environmental Assessment Act 2000, later followed by the National Environment Protection Act 2007, and the Waste Prevention and Management Act 2009, early key national policies made little or no reference to climate change.

The Middle Path - National Environment Strategy for Bhutan

Published in 1998 by the National Environment Commission of the Royal Government of Bhutan, The Middle Path - National Environment Strategy for Bhutan serves as key strategic document on achieving sustainable development through hydropower, increase of self-sufficiency in food production, and industrial development. The guiding principle is to meet socio-economic changes and challenges of the twenty-first century

without compromising cultural heritage, environment, and natural resources (NEC 1998: 93).

Choosing a middle path for development the document outlines the three economic avenues of developing hydropower, agriculture, and industry based on environmental impact assessments to secure integrated watershed management, sustainable agricultural practises, pollution control, and environmental legislation, combined with family planning policies to control population growth and demographic changes leading to stresses on limited land resources (NEC 1998: 29, 92). Though all of these sectors are sensitive to climate change induced impacts the document reflects no linkages neither to potential vulnerabilities nor to contributions to climate change.

Climate change only is considered in the context of the country's vast forest cover serving as carbon sink mitigating effects of climate change and offsetting emissions of local industry as well (NEC 1998: 31). And with reference to the efforts of stabilising carbon dioxide emissions in the atmosphere under the United Nations Framework Convention on Climate Change (UNFCCC), which Bhutan already had ratified in 1995, and to the recommendation of the Intergovernmental Panel on Climate Change (IPCC) to increase carbon sinks the Middle Path document states the great potential of Bhutan for carbon trade arrangements (NEC 1998: 59).

Bhutan 2020: A Vision for Peace, Prosperity and Happiness

Published by the then Planning Commission (the subsequent Gross National Happiness Commission) in 1999, just one year later than the middle path strategy from 1998 of the National Environment Commission, the key twenty-year vision document Bhutan 2020: A Vision for Peace, Prosperity and Happiness provides a broad framework for the future development of the country. The document reviews the achievements of the past three decades and takes stock of the challenges for the people, economy, environment, and institutions (PC 1999a: 10). Setting out the directions for the Bhutanese path of development main goals and guiding principles are established to achieve the key objectives of human, cultural, balanced, and equitable development as well as institutional and environmentally sustainable development (PC 1999b: 5).

The envisaged economic growth, mainly based on large hydropower generation, is expected to lead the country to a high level of self-reliance becoming independent on external aid, thus, sustaining its further socio-economic development and improved standards of living conditions (GNHC 2009: 19). However, the vision document has no reference to climate change. Also when painting a picture of Bhutan in the year 2020 as the expected result of successful development climate change is not mentioned (PC 1999b: 69-77). This indicates that awareness of climate change was rather limited at that time to a few experts without much dissemination across development sectors.

Biodiversity Act of Bhutan 2003

Following the ratification of the Convention on Biological Diversity in 1995 in order to promote conservation of natural resources and protection of biodiversity Bhutan's parliament adopted the Biodiversity Act of Bhutan in 2003. This law focuses on regulating the access to genetic resources and protection of plant varieties. Besides conservation and sustainable utilisation of genetic resources the act promotes equitable sharing of the benefits of the rich biodiversity (Biodiversity Act of Bhutan 2003: 1). In this context, local communities receive special recognition as their traditional knowledge, properties, and practices of using biological resources are protected (Biodiversity Act of Bhutan 2003: 2, 24).

Beyond the regulations of the Biodiversity Act local research has highlighted that native crops and livestock are adapted to the country's weather conditions and mountainous terrain. Hence, maintaining genetic variety is considered as strategically relevant for sustainable agriculture and food security, and to avoid further loss of local biodiversity given the trend to cultivate introduced high-yield crops and breed imported livestock species for improved productivity but with requirement of specialised management and higher risks for diseases (Tshewang: 3, 6). However, the act does not provide any references to potential impacts of climate change on environment, biodiversity, and genetic resources.

National Disaster Risk Management Framework 2006

An early exception is the document called National Disaster Risk Management Framework - Reducing Disaster Risks for a Safe and Happy Bhutan, which links

potential risks of natural disasters to climate change. Developed in 2006 by the Department of Local Governance (DLG) under the Ministry of Home and Cultural Affairs, the framework highlights that threats from glacial lake outburst floods (GLOFs), flash floods, landslides, and forest fires are likely to worsen due to the alarming rate of climate change and global warming and will cause significant impacts on the country's fragile mountain ecosystems (DLG 2006: 5, 8). At the same time, Bhutan is experiencing more extreme weather patterns resulting in storms, droughts, excessive rainfall, and increased volumes of floods and surface runoff, with the sectors of water resources and agriculture being most sensitive to climate change, and the rich biodiversity being threatened simultaneously by climate change and rapid urbanisation as well (DLG 2006: 21, 61).

The document also points out that existing constraints in budget and technologies are hindrances for climate change adaptation measures and contradictory to Bhutan's increasing climate vulnerability, and emphasises the need to link disaster risk management to development planning (DLG 2006: 56, 28). Given the high priority of further "promoting a risk management approach to dealing with disasters rather than only a reactive approach that deals with the aftermath of disasters in an ad hoc manner" (DLG 2006: 34), subsequently, Bhutan's government established new institutional arrangements such as the upgrading of the former Disaster Management Division of the Department of Local Governance to the Department of Disaster Management under the Ministry of Home and Cultural Affairs as the nodal agency to coordinate disaster risk management in the country. Moreover, disaster risk reduction was included into the cross cutting issues of development planning together with gender, environment protection, climate change, and poverty alleviation (GECDP), to be coordinated by the mainstreaming reference group (Thinley 2013: 1).

National Adaptation Programme of Action (NAPA)

Policy development on climate change further improved from 2006 onwards, when the National Adaptation Programme of Action (NAPA) was developed in Bhutan. To support least developed countries (LDCs) to develop national climate change mechanisms and build capacity, the United Nations Framework Convention on Climate Change (UNFCCC) in 2001 at the Conference of the Parties (COP 7) in Marrakesh,

Morocco, established the so called National Adaptation Programmes of Action (NAPAs). Through these NAPAs LDCs can identify their urgent adaptation needs and receive funding for projects (UNFCCC 1).

The 2006 NAPA for Bhutan presents nine priority projects of climate change adaptation for the Himalayan country, namely a disaster management strategy to plan for food security and emergency medicine for vulnerable communities; the artificial lowering of the Thorthormi Lake prone to glacial lake outburst flood (GLOF); a weather forecasting system for agriculture; landslide management and flood prevention in selected critical areas; flood protection of downstream industrial and agricultural zones; rainwater harvesting; GLOF hazard zoning within the pilot area of the Chamkharchhu basin; installation of an early warning system in the Phochhu basin; and promotion of community-based forest fire management and prevention (UNFCCC 4).

In excess of funding from UNFCCC a least developed country's NAPA can be useful in seeking financial assistance from bilateral donors or designing multi donor cooperation for climate projects. In 2008, the three priority activities of lowering the level of Thorthormi glacial lake, installing a flood early warning system, and GLOF hazard zoning plus capacity building of local communities in disaster risk management were clubbed together under the first and pioneering NAPA project titled 'Reducing climate change induced risks and vulnerabilities from glacial lake outburst floods in the Punakha, Wangdi and Chamkhar valleys', funded by the Least Developed Country Fund with cofinancing from the Royal Government of Bhutan, the United Nations Development Programme, the Austrian Development Cooperation, and the World Wildlife Fund (NEC 2012a: 13).

Thorthormi Lake in Lunana gewog in Gasa dzongkhag has been identified as one of Bhutan's most dangerous glacial lakes with a worst-case-scenario outburst projection as early as 2010. Melting ice from receding glaciers is increasing the volume of water in the glacial lake, and the destabilisation of its ice-cored moraine dam was critically increasing the risk of a glacial lake outburst flood (GLOF) with devastating consequences in the downstream valleys. Starting from 2009 under the NAPA project, a multidisciplinary team together with about 350 labourers has been working in the short summer seasons from July to October in the cold and harsh environment above

4,200 metres (13,780 feet), far away from roads and settlements. Since use of heavy equipment was not possible at the high altitude site excavation work was done manually with simple tools digging ice and removing huge boulders from the lake to create a channel as permanent drainage (DDM 2). By 2012, with the final assistance of more than one hundred Royal Bhutan Army personnel, the water level of the glacial lake could be lowered by five meters (RBA 1).

Given the facts that previously not considered climate risks such as cyclones and windstorms have emerged, and infrastructure and population at risk is increasing, revisiting and recalculation of the priority projects not implemented since 2006 under NAPA seemed appropriate (Khandu 2014: 27). Therefore in 2012, project profiles were updated and the revised version of NAPA II was published, presenting the eight key priority areas of intervention of landslide management and flood prevention; disaster risk reduction and emergency medical services for communities; national capacity building for weather stations and seasonal forecasting; climate resilient and eco-friendly road construction by national engineering institutes; food security and climate resilience for communities; flood protection for industrial zones; rainwater harvesting and adaptation to droughts; and management and prevention of forest fires at community level (NEC 3).

The updated National Adaptation Programme of Action (NAPA) II document presents climate change adaptation options tabulated by sectors relevant to development, for instance the strongly interlinked sectors of water resources, agriculture, and forests. For water resources some of the potential options recommended are to raise awareness of communities on sustainable use of water resources, to improve land use in degraded water catchment areas and promote afforestation, and to improve watershed management as well as efficiency in irrigation (NEC 2012a: 26).

The agriculture sector could benefit from adaptation options such as introducing crop and livestock resistant to extreme temperature and rainfall, reducing soil erosion and water run-off on slopes, improving cold storage facilities for food grains for times of crop damage and loss, developing climate resilient farm technologies, and creating off-farm employment opportunities (NEC 2012a: 26). And for forests and biodiversity some adaptation options proposed are to promote community-based forest

management, conserve land, water resources, and wood production, and to conduct research in trees more resistant to insect damages, diseases, and forest fires (NEC 2012a: 27).

As of 2016, the current NAPA II project, being implemented in the period from 2014 to 2017, focuses on raising capacities at national, district and community level to reduce climate change induced risks potentially causing human and economic losses. The sixty-six million US dollar project, supported with eleven million US dollars by the UNFCCC's Least Developed Countries Fund, includes practical measures against floods and landslides recurrently threatening the commercial town of Phuentsholing, the main southern border town and gate to India, and the adjoining industrial zone of Pasakha. Furthermore, water resources management and water harvesting for selected communities facing water scarcity, and expanding meteorological stations for improved local weather forecasting are planned to be implemented (RGoB 2014: 1-2).

Strategising Climate Change for Bhutan 2009

As focal agency for climate change the National Environment Commission (NEC) plays the lead role in coordinating climate change issues in Bhutan. Building on the experiences of the NAPA process since 2006 and also recognising the need of strengthening institutional capacities NEC in 2009 prepared a document on strategising climate change. The publication basically features a status report on climate change observations and potential impacts in Bhutan including a sector vulnerability assessment and requirement analysis. This climate change assessment also facilitated the preparation of the NAPA II document in 2012.

Out of NEC's recommendations from 2009 some proposed institutional arrangements have been implemented in the meantime, such as the establishment of the Climate Change Division within NEC to enhance its own institutional capacity, and the creation of a multi-sectoral technical committee on climate change, as well as the formation of a multi-agency mainstreaming reference group for incorporating cross cutting issues of climate change together with gender, environment protection, disaster risk reduction, and poverty alleviation into development planning (NEC 2009: 10, 12; Thinley 2013: 1).

The 2009 NEC report on strategising climate change also shows that several climate change related projects and technical assistance for policy development have been implemented by various agencies funded by different donors, yet, the absence of a national climate change policy inhibited streamlining and cross-sectoral synergies. Nevertheless, NEC continued to play the key role in developing NAPA II in 2012 and implements the current NAPA II project since 2014.

National Adaptation Plan (NAP)

While activities under National Adaptation Programmes of Action (NAPAs) are ongoing in several least developed countries including Bhutan, the need for more comprehensive adaptation planning beyond single projects was identified and led to the formulation of the Cancun Adaptation Framework in 2010 at the UNFCCC Conference of the Parties (COP 16) in Cancun, Mexico (UNFCCC 1). Under this framework, the national adaptation plan (NAP) process was established to support adaptation planning specifically in least developed countries (LDCs). Developing this broader framework of “national adaptation planning can enable countries to assess their vulnerabilities, mainstream climate change risks, and address adaptation” (UNFCCC 2012: 5). These NAPs are meant to identify long-term adaptation needs through “a continuous, progressive and iterative process which follows a country-driven, gender-sensitive, participatory and fully transparent approach” (UNFCCC 2).

Especially in least developed countries like Bhutan risks of climate change are causing additional challenges to development. UNFCCC supports adaptation planning within the context of planning sustainable development. Hence, NAPs are intended to assist least developed countries to become more resilient by reducing their vulnerability to the impacts of climate change and integrating climate change adaptation into development planning (UNFCCC 3).

Contextualising these overall approaches for the process of developing a NAP for Bhutan means to build on existing experiences and project activities of various sectors including NAPA projects, incorporate already identified adaptation priorities and align them with key objectives of national development planning in order to formulate a comprehensive and coherent long-term adaptation and development plan for the country (UNFCCC 2012: 7-8).

The NAP formulation process roughly can be divided into four main steps comprising laying the groundwork, preparatory elements, developing implementation strategies, and monitoring and review (UNFCCC 2012: 12). The first step of laying the groundwork includes stocktaking of available information on climate change, analysing capacity needs and assessing development goals of the country. During the second more comprehensive step of preparation climate change scenarios need to be analysed, assessments of climate vulnerabilities and adaptation options undertaken, the NAP has to be compiled and climate change adaptation needs to be integrated into national development planning. The third step of implementation requires the formulation of a long-term implementation strategy, enhancement of adaptation capacities and prioritisation of climate change adaptation in the national development plans. Monitoring, reviewing and updating the NAP as necessary sums up the fourth step (UNFCCC 2012: 6, 12).

Several of these tasks required for formulating a NAP for Bhutan already have been mastered, mainly under the lead of the Climate Change Division of the National Environment Commission (NEC), in the emerging process of systematically dealing with climate change at the national level during the last decade. For instance, sector-wise vulnerability assessments have been conducted and adaptation options have been identified. The country also is actively participating in UNFCCC conferences, and the head of NEC's Climate Change Division is a member of the Least Developed Countries Expert Group for technical support and advice, established in 2001 as an outcome of the UNFCCC Conference of the Parties (COP 7) in Marrakesh, Morocco. Hence, regular flow of information and knowledge exchange on climate change has been institutionalised.

However, apart from some early consultation and basic information activities undertaken by NEC a systematic process to develop Bhutan's NAP has not been embarked until 2016. Mainly due to time constraints of the handful of national climate experts, further needs for capacity building at national, sectoral and local level, and also lack of funding the development of a roadmap for the NAP formulation process under participation of all sectors is overdue (Personal communication NEC 2015). Reiterated in the Intended Nationally Determined Contribution (INDC) delivered to

UNFCCC prior to the Paris climate change conference in December 2015, “Bhutan views the process to formulate and implement National Adaptation Plans (NAPs) as an important means towards reducing vulnerability by both integrating climate change adaptation into national development planning and also implementing priority adaptation actions on the ground. Bhutan will be fully engaged in the NAP process and begin the formulation of the first NAP once support is received” (NEC 2015: 5).

Finally in the year 2016, with support from the United Nations Development Programme (UNDP), NEC has undertaken first steps to develop a proposal for receiving financial support from UNFCCC’s Least Developed Countries Fund to prepare the process of formulating Bhutan’s first National Adaptation Plan (NAP), which is planned to be carried out latest by 2019 (NEC 2016: Annex II: 7, 11-12).

Bhutan Sustainable Hydropower Development Policy 2008

Main policy objectives are to contribute to the government’s revenue, ensure electricity supply for domestic demand and generate clean energy to mitigate negative effects of climate change (MoEA 2008: 6). As the small mountainous country’s socio-economic development largely depends on revenues from hydropower export to India, besides the royalties in hard currencies from high-taxed package tours of international tourists, sustainable hydropower development is crucial for the economic pillar of gross national happiness. With large power plants under construction and in the pipeline, growing energy demand in the Southeast Asian region offers additional opportunities for export of hydroelectricity, for instance to Bangladesh, provided that agreements on using transmission lines through India can be negotiated.

Hydropower projects regularised by this policy are classified as medium projects with an installed capacity of more than twenty-five and up to 150 megawatts (MW), large projects with more than 150 MW and up to 1,000 MW, and mega projects with a capacity of more than 1,000 MW (MoEA 2008: 8). Whereas development of micro and mini hydropower projects with an installed capacity of up to one MW, as well as small hydropower projects of more than one and up to twenty-five MW shall be regulated by a separate renewable energy policy to be formulated (MoEA 2008: 8-9), which was adopted five years later in 2013 as the Alternative Renewable Energy Policy.

For using water resources for hydropower generation the policy promotes the necessity of protecting water catchment areas through sustainable land use practices and nature conservation, thus calling for establishing integrated sustainable water resources management in cooperation between the economic and the agriculture ministry (MoEA 2008: 17). By generating clean renewable energy in Bhutan without environment pollution and greenhouse gas emissions the policy recognises the opportunities provided by the Clean Development Mechanism under the 2001 Kyoto Protocol for earning tradeable credits through export of clean energy reducing “energy generation from sources which contribute to global warming and environmental damages” (MoEA 2008: 15), thus offsetting emissions in the importing country. Furthermore, the policy notes the generation of clean hydropower as key contribution to mitigate negative impacts of climate change. However, potential adverse impacts of climate change to the water sector as the main national resource for development are not considered.

National Forest Policy of Bhutan 2009

Since time immemorial rural communities in Bhutan used surrounding natural resources as part of their livelihoods. With the onset of multi-year national development planning in the early 1960s and the first ever Forest Act in 1969 former community level management of natural resources was centralised and land not registered under an individual land title document (thram) was declared forest land under state proprietorship (MoAF 2009: 1-2). In 1974 a first forest policy was formulated regulating conservation of forests and wildlife, and for the first time stipulating to keep a minimum of sixty percent of the country forested for all time, a provision which was adopted thirty-four years later in 2008 by article 5.3 of the first constitution of Bhutan.

Next step in forest policy development was the Forest and Nature Conservation Act of Bhutan promulgated in 1995, which elaborated on forest management, soil conservation, and protected areas for environment and wildlife, and also recognised “the traditional and cultural rights of local people to access and use of forest resources reversing the provisions of the 1969 Act which restricted these rights” (MoAF 2009: 2). This revised forest legislation provides options for forest use of private land owners

and for community forests on government reserved forest (GRF) lands. This substantial shift in Bhutan's forest laws also contributed to the later process of decentralisation and community participation in natural resources management linked to poverty reduction, changing the "primary focus on protection and conservation towards a focus on balancing conservation with sustainable utilisation" (MoAF 2009: 1).

The 2009 National Forest Policy of Bhutan focuses on sustainable forest management including the integration of climate change and disaster management, and specifically promotes under its policy measures "to generate knowledge, information and technology to support policy implementation and development including integration of climate change issues" (MoAF 2009: 5-6, 9). Though still broadly formulated the policy at least recognises under its priorities for sustainable use of forest and environmental services the need to "reduce impact of climate change on sustainable forest management and development through appropriate adaptation and mitigation measures" (MoAF 2009: 10).

Economic Development Policy of the Kingdom of Bhutan 2010

Setting the agenda for the development of key sectors to achieve sustainable socio-economic development as one of the four pillars of the concept of gross national happiness, and economic self-reliance by the year 2020, the Economic Development Policy of the Kingdom of Bhutan 2010 aims at facilitating environment friendly growth in industry and private sector development. For this purpose, economic development "shall take into account environment mainstreaming in a phased manner that allows for industries to grow as well as engage in cleaner production" (RGoB 2010: 5).

In Bhutan's economy the energy sector based on hydropower has proved to be the main economic driver of the least developed country. With more hydropower plants under construction and in the pipeline revenues from hydroelectricity generation are expected to further boost socio-economic development and support environment conservation through clean energy use (RGoB 2010: 10). While the major part of electricity is exported to India the growing domestic demand has to be met as well. In the context of energy security, the policy points out the need to allocate capacities and to develop electric storage projects. Linked to energy security as well is the policy's

recommendation to develop other renewable energy sources than hydropower, such as solar power and wind energy (RGoB 2010: 11).

At the same time, the proposed development of alternative renewable energy sources of solar, wind, and biomass together with improved energy efficiency is considered as relevant contribution to climate change mitigation efforts in reducing greenhouse gas emissions in order to fulfil Bhutan's political commitment to remain carbon neutral for all times (RGoB 2010: 12). While the main focus clearly remains on hydropower development, the economic policy also calls for formulating a separate renewable energy policy to facilitate the development of alternative clean energy sources (RGoB 2010: 12), which was adopted three years later in 2013 as the Alternative Renewable Energy Policy.

The Water Act of Bhutan 2011

An early water policy formulated in 2002 already highlighted the importance of watershed management to protect good quality of water resources, and emphasised conservation of soil and forests and enhancement of forest areas, also in the context of flood prevention (MoAF 2009: 3). In 2011, three years after the first democratically elected government came into power, protection of the country's water resources was legally formalised in the Water Act of Bhutan to ensure conservation and management "in an economically efficient, socially equitable and environmentally sustainable manner" (The Water Act of Bhutan 2011: 3).

Counting on active participation of citizens as laid down in the 2008 constitution, referring to all Bhutanese as trustees of environment and natural resources, the Water Act requests everybody for cooperation to conserve and protect watersheds and catchment areas, and, at the same time, guarantees all people the right of access to safe and affordable water for their basic needs (The Constitution of the Kingdom of Bhutan 2008: 11; The Water Act of Bhutan 2011: 3-4).

The bill regulates use of irrigation water for agriculture, instructs protection of water resources in forests, promotes harvesting and storage of additional water sources like ground water, rain water or even fog to minimise water scarcity during dry seasons,

and calls for minimising the risks of floods and effects of flood damage (The Water Act of Bhutan 2011: 24, 26-27).

Actually, all these measures also are suitable to be incorporated into adaptation planning for climate change induced impacts on water resources. However, climate change explicitly is mentioned only once in the act's preamble, where the threat of climate change is generally recognised together with other anthropogenic threats on the country's water resources, though without further exemplification of potential negative impacts of climate change. The overall social and cultural context of the legislation's goal of protecting environment and human health through management of water resources is described as "pursuit of Gross National Happiness and the age old tradition of living in harmony with nature" (The Water Act of Bhutan 2011: 1).

National Action Plan Biodiversity Persistence and Climate Change 2011

Prepared by the National Biodiversity Centre (NBC) under the Ministry of Agriculture and Forests, the document addresses concerns about ecosystems and biodiversity and their vulnerability to climate change. Local research in Bhutan in 2010 unveiled a general poor understanding of climate change and preparedness of people for its potential impacts although local communities have observed weather changes such as more erratic rainfall, longer spells of drought, and decreasing snowfall patterns together with temperature increase over the last decade (NBC 2011: 9-11). The action plan document highlights the importance of agricultural biodiversity, as broad genetic diversity of native crops and livestock offers better opportunities for cultivation and breeding of more climate resilient species than the reduced variety of introduced imported high-yield crops and breeds (NBC 2011: 18-19).

Hence, protection of agricultural biodiversity is considered essential to conserve "the broadest possible genetic diversity as an insurance against risks posed by climate change" (NBC 2011: 20). Furthermore, reportedly increased incidences of insect outbreaks and diseases in forests and agriculture are compromising forests, harvests, and livestock necessitating nationally coordinated management of pest and diseases (NBC 2011: 20-21). The document also points at risks of biocultural loss in the case of extinction of native plants significant for cultural traditions and rituals which might lead to degrading cultural practices and indigenous knowledge (NBC 2011: 21).

At the same time, the document addresses existing huge knowledge gaps and lack of comprehensive data on ecosystems and biodiversity and their vulnerability to climate change, together with limited national meteorological observation data, and calls for coherent policy development to incorporate potential adverse climate change impacts on biodiversity into relevant environmental policies (NBC 2011: 22-23).

Finally, a detailed national action plan formulates key goals such as to establish proper documentation of biodiversity and climate change impacts in Bhutan, maintain ecosystems and minimise adverse climate change impacts on biodiversity, improve capacity building and cross-sectoral coordination on biodiversity and climate change, promote mainstreaming of biodiversity and climate change into policy development, and reduce climate change vulnerability of rural communities (NBC 2011: 26).

To further strengthen biodiversity knowledge and protection in the country subsequently the National Biodiversity Strategies and Action Plan Bhutan 2014 was formulated in a multi stakeholder process under the lead of the Ministry of Agriculture and Forests, specifying targets, timeframe, and actions. Regarding knowledge gaps on climate change and biodiversity as reported in the 2011 action plan the target number ten set in the 2014 document addresses the overdue identification of potential climate change impacts on ecosystems and the strengthening of adaptation measures by the year 2020 (NBC 2014: 96).

Subsequently, following the principle of precaution, the Biosafety Act of Bhutan 2015 was enacted by Bhutan's parliament to restrict and regulate use and dissemination of genetically modified organisms and products thereof in order to protect environment and biodiversity, as well as health of people and animals, and to promote food security (Biosafety Act of Bhutan 2015: 1, 9-13).

National Strategy and Action Plan for Low Carbon Development 2012

Formulated as long-term strategy the document's main purpose is to support Bhutan's commitment to carbon neutrality announced in 2009 at the UNFCCC conference (COP 15) in Copenhagen, Denmark, stipulating the country's role as a net sink for greenhouse gases. To ensure that greenhouse gas (GHG) emissions will always remain below the sequestration capacity of Bhutan's forests the strategy paper outlines

detailed scenarios on emission trends and potentials of emission reduction of key sectors until the year 2040. Emissions are categorised as energy related emissions such as transport and industrial, commercial and residential energy consumption, and non-energy related emissions mainly from industrial processes, agriculture, and municipal solid waste (NEC 2012b: iii).

Under a business-as-usual scenario the country's total GHG emissions are projected to more than double from 2.2 million tonnes in 2010 to 4.7 million tonnes by 2040, yet, still below the national forest's sequestration capacity of estimated 6.3 million tonnes carbon dioxide. The projection is based on the assumption that economic growth will lead to increase in energy services and consumption, with energy related emissions increasing by almost ninety percent and non-energy related emissions by about 110 percent, leading to rapidly increasing carbon emissions (NEC 2012b: iii-iv).

Significantly rising carbon emissions by more than 400 percent from 2010 to 2040 are expected to come from Bhutan's industries producing cement, ferro-silicon, and calcium carbide using fossil fuels in their manufacturing processes. To achieve low carbon development in the industrial sector the paper recommends to improve energy efficiency, replace fossil fuels by renewable energy sources and introduce modern standards for emission reduction, while recognising that necessary major investments for these mitigation measures are not yet calculated. Recommendations for emission reduction in the transport sector include improvement of public transport and promotion of electric cars together with area planning for cyclists and pedestrians, and the residential sector is requested to improve energy efficiency in buildings and to introduce solar heating for water and space (NEC 2012b: vi-vii).

The low carbon strategy paper unveils that Bhutan's commitment to carbon neutrality, though aligned with the constitutional condition to keep sixty percent of the country forested and with the promotion of green growth of the Economic Development Policy 2010, remains a challenging task between economic and environmental interests.

Alternative Renewable Energy Policy 2013

Key policy objective of the Alternative Renewable Energy Policy 2013 is to broaden the mix of renewable energy sources in view of rising domestic demand, growing imports

of fossil fuels, and increasing reliance on hydropower as main energy source of Bhutan, also considering reduced hydroelectricity generation during winter seasons with low river flows. However, promoting diversification of renewable energy sources seems to be challenging, as the focus of Bhutan's energy sector clearly lies on large-scale hydropower development as widely available clean energy for affordable domestic consumption and for profitable export to neighbouring India. On the other hand, domestic market for alternative renewable energy sources seems to be more limited, and generation costs of alternative energy are considered as not competitive with hydroelectricity, particularly in view of subsidised domestic electricity tariffs.

To meet these challenges, the policy recommends developing appropriate pricing and incentive systems for alternative renewable energy technologies and the phasing out of government subsidies for fossil fuels (RGoB 2013: 5, 19). To gradually substitute fossil fuels imported from India exploration of alternative energy options for traffic such as electric and hybrid cars or use of biofuels are promoted. However, potential development of biofuel production and use has to prevent any negative effects on Bhutan's food security (RGoB 2013: 18, 19).

For the development of alternative renewable energy sources the minimum target set to be achieved by the year 2025 consists of generating twenty megawatts (MW) mainly from solar power, wind, and biomass (RGoB 2013: 6). The policy also covers the development of micro and mini hydropower projects with an installed capacity of less than one MW or up to one MW respectively, as well as small hydropower projects of more than one and up to twenty-five MW, while larger hydropower plants are regulated by the Bhutan Sustainable Hydropower Development Policy 2008 (RGoB 2013: 4; MoEA 2008: 8-9).

Project developers are encouraged to register their renewable energy projects under the Clean Development Mechanism (CDM) or subsequent instruments to avail financial benefits (RGoB 2013: 26), as the carbon market enables selling of credits to industrialised countries to partly substitute their commitments for carbon emission reduction in their own countries. While the government is requested to support research, knowledge transfer and public awareness on alternative renewable energy sources, the establishment of the Renewable Energy Development Fund, already

proposed in 2008 by the Sustainable Hydropower Development Policy (MoEA 2008: 14), shall assist to create a supportive environment for investments and technology production such as solar water heating, biogas plants, and energy efficient cooking stoves (RGoB 2013: 23-25).

Considering a more diversified mix of energy production the policy also mentions climate change as a threat (RGoB 2013: 2), though without further exemplification of potential adverse impacts of climate change on energy sources. In the long term the policy aims to increase energy security together with sustainable socio-economic development and environment conservation, while contributing to mitigate climate change through reduction of greenhouse gas emissions from fossil fuels usage (RGoB 2013: 5).

Technology Needs Assessment and Technology Action Plans for Climate Change

Mitigation 2013

Technology transfer to least developed countries to assist national governments in mitigating climate change is promoted by the United Nations Framework Convention on Climate Change (UNFCCC) and has been discussed at various UNFCCC conferences. Building on the results of the earlier National Strategy and Action Plan for Low Carbon Development 2012 and following a multi stakeholder consultative process under the lead of the National Environment Commission (NEC) Bhutan has assessed its technology needs for reducing carbon emissions. Three intervention areas with top priority for mitigating climate change were selected, namely waste disposal, transportation, and manufacturing industries together with the construction sector, and consequently, prioritised technologies were identified applicable for national implementation (NEC 2013a: 2).

Greenhouse gas emissions from solid waste disposal, increasingly accumulating because of rapid urbanisation due to rural-urban migration and population growth in conjunction with changing consumer behaviour, are planned to be reduced by promoting composting as well as the principle of reducing, reusing and recycling of waste. Promotion of biogas plants for anaerobic digestion of livestock manure will lead to reduced methane emissions, production of biogas replacing fossil fuels, and utilisation of the residue as natural fertiliser (NEC 2013a: 14, 36, 45).

Biogas plants are an internationally proven technology and already have been piloted in Bhutan in 2011 in four southern dzongkhags, namely Tsirang, Sarpang, Samtse, and Chukha, by the Bhutan Biogas Project (NEC 2013a: 46). Funded by the Asian Development Bank (ADB) and supported with government subsidies 2,921 biogas plants in seventeen dzongkhags have been installed under the Bhutan Biogas Project (BBP) as of July 2016. Till the expected completion of the project by end of 2016 BBP intends to achieve the total number of 3,630 installed biogas plants (MoAF 5). Countrywide upscaling of installing biogas plants for rural communities with livestock farming is an applicable measure to improve livelihoods and reduce fossil fuel use, thus contributing to climate change mitigation.

For the transport sector prioritised technologies recommended are the introduction of transport management systems, improvement of mass transit for instance by electric bus networks for extended public transportation, and development of non-motorised transport such as improved facilities for pedestrians and cyclists (NEC 2013a: 27, 51, 53).

Key recommendations for the manufacturing industries focus on introducing high efficiency electric motors especially in Bhutan's cement, iron and steel, and ferro alloy industries with an estimated energy saving potential up to twenty-five percent, as well as waste heat recovery in form of steam from industry production which could be utilised for water heating, room heating and cooling, or as a new energy input for production processes (NEC 2013a: 36, 57, 59).

Whereas for the construction sector recommended priority technologies comprise construction of energy efficient infrastructure with proper insulation and double glazed windows and implementation of energy efficient lighting, heating and cooling systems. The document references the Indian Energy Conservation Building Code (ECBC) introducing energy performance standards for buildings aligned with different climate zones of the subcontinent (NEC 2013a: 36, 55). ECBC possibly could be applied to Bhutan as well considering similar climate conditions of the northern states of India, and maybe also in view of the work force for construction projects in Bhutan which by the majority consists of Indian engineers and labourers.

Technology Needs Assessment and Technology Action Plans for Climate Change

Adaptation 2013

Parallel to the technology needs assessment exercise for climate change mitigation following a multi stakeholder consultative process under the lead of the National Environment Commission (NEC) the task force also has assessed Bhutan's technology needs for adaptation to climate change. The three top priority intervention areas selected are water resources, agriculture, and natural disasters and infrastructure (NEC 2013b: 2). Agriculture and hydropower are key sectors of Bhutan's economy, both highly sensitive to climate change, while the road system is the key transport infrastructure in the mountainous Himalayan country, apart from mountain footpaths for villagers, horses and yaks, and few domestic flights with small aircrafts.

Prioritised technologies identified for the water sector include micro hydropower projects for remote areas, also encouraged by the Renewable Energy Policy 2011, which can be operated by local communities reducing their use of kerosene and firewood, as well as rooftop solar cells to further diversify energy sources, both technologies reducing demand from on-grid electricity supply from large-scale hydropower plants (NEC 2013b: 43, 46). Key adaptation technology for the water sector selected to be implemented on priority basis is building of efficient irrigation systems such as sprinkler and drip irrigation (NEC 2013b: 3, 48).

For the agriculture sector prioritised adaptation technologies include agro-forestry, which combines agricultural practises with planting of trees to conserve soil fertility and prevent soil erosion and land degradation, offering additional income opportunities for farmers as well (NEC 2013b: 3, 50). Furthermore, sloping agriculture land technology (SALT) is promoted to prevent soil erosion in mountain agriculture through planting of hedgerows as natural barriers along steep fields, thus maintaining soil fertility and increasing crop yields (NEC 2013b: 3, 52). Finally, the top prioritised adaptation measure identified in the document aims at the development of drought and pest resistant varieties of crops, utilising indigenous knowledge in combination with modern biotechnology, to enhance domestic food security through cultivation of climate resilient staple foods (NEC 2013b: 3, 55).

For the third priority sector of natural disasters and infrastructure real time weather stations and weather forecasting, and community based early warning systems are recommended. Actually, the proposal for a weather forecasting system for agriculture already was articulated in 2006 as one of the nine priority projects of Bhutan's National Adaptation Programme of Action (NAPA), but could not be implemented due to lack of funds. But early warning systems (EWS) for floods are proven and suitable for upscaling and expanding to also monitor various meteorological conditions. Knowledge and experiences have been gained when EWS technology comprising upstream flood sensors and siren towers along the downstream valleys, together with capacity building of local communities, hazard zoning maps and identification of evacuation areas were implemented through Bhutan's first NAPA project of lowering Thorthormi Lake to prevent a glacial lake outburst flood (GLOF).

Finally, construction of climate resilient roads is highlighted as top priority adaptation technology for the infrastructure sector (NEC 2013b: 3). Frequent road damages and blocks caused by torrential rain, flash floods, landslides and boulders, and heavy vehicle movement for the large hydropower plant construction sites as well, together with general low quality of road construction makes the national road network as the economic lifeline of the mountain country unreliable and perilous. Stabilising slopes through walls and planting, securing rocky slopes through gabions, improving road drainage and introducing improved engineering such as proper preparation of roadbed and usage of quality durable materials for pavement are some of the adequate measures to enhance climate resilience of roads, as climate change is expected to aggravate frequency and intensity of extreme weather events (NEC 2013b: 59).

Food and Nutrition Security Policy of the Kingdom of Bhutan 2014

Based on the recognition of the people's right to have access to quality food and of food security as a matter of national security for the small landlocked nation with high dependence on food imports mainly from India, the Food and Nutrition Security Policy of the Kingdom of Bhutan 2014 promotes nutritious and healthy food consumption to prevent malnutrition, sustainable local food production, and the maintenance of national food reserves, managed by the Food Corporation of Bhutan (FNSP 2014: 1, 9).

The policy considers climate change as potential threat to food production through changes in temperatures and precipitation and increasing extreme weather events resulting in affected yields and crop losses (FNSP 2014: 5). Thus, one of the policy objectives explicitly addresses the development of climate change mitigation and adaptation measures, such as enhancing agricultural biodiversity, as highlighted by the earlier National Action Plan Biodiversity Persistence and Climate Change 2011, by diversifying domestic crops and livestock towards more stress and climate resilient species to ensure food security (NBC 2011: 18-19; FNSP 2014: 13). Other climate relevant measures identified for food security are promotion of climate smart agriculture, watershed protection, sustainable land management to combat land degradation, and availability of quality seeds (FNSP 2014: 13).

Another objective of the food security policy addresses the need to improve preparedness for natural disasters, likely to increase by adverse impacts of climate change, for instance through monitoring and early warning systems for weather conditions together with status of crop production, food related market information, and through integration of strategies to distribute relief food into disaster management plans (FNSP 2014: 13). However, the latter measure was identified as early as in 2006 in the National Adaptation Programme of Action (NAPA) as one of the priority projects for climate change adaptation, namely to develop a disaster management strategy to plan for food security and emergency medicine for vulnerable communities (UNFCCC 4), but lack of funding obviously has kept it pending.

Line agencies mentioned in the policy document are the Ministry of Agriculture and Forests, responsible for ensuring food security, and the Ministry of Health for implementing nutrition security (FNSP 2014: 15). Other agencies with crosslinks to food security would be for instance the Department of Disaster Management under the Ministry of Home and Cultural Affairs; the Ministry of Education for awareness programmes on nutrition and healthy food consumption; the National Land Commission (NLC) with its national rehabilitation programme for landless and socio-economically disadvantaged people (NLCS 1); and the Ministry of Economic Affairs for safe food imports and renewable energy sources for domestic food production.

Review observations

Detailed climate change assessments have been conducted by the Climate Change Division of the National Environment Commission with their experts linked to international institutions, and the National Biodiversity Centre under the Ministry of Agriculture and Forests has raised specific concerns on ecosystems and biodiversity and their vulnerability to climate change. However, sector policies and national bills show some general awareness but mostly do not contain accurate reflection of climate change impacts and strategic responses.

While the Water Act of Bhutan 2011 for instance promotes protection of water resources in forests and harvesting of additional water sources to reduce water scarcity in dry seasons, and the Bhutan Sustainable Hydropower Development Policy 2008 promotes protection of water catchment areas through sustainable land use and nature conservation, these measures are suitable as well to be incorporated into a broader adaptation planning to climate change induced impacts on water resources for hydropower, drinking and irrigation water.

It is noted that specifically the water sector could experience severe threats from climate change, with adverse impacts on the nation's energy sector nearly exclusively relying on hydropower generation for domestic demand and for export of hydroelectricity contributing to the government's revenues. Though river water appears as an unlimited renewable natural resource, hydropower plants are prone to disruption due to erratic precipitation, flash floods, and potentially stronger seasonal changes in river flows, together with increasing sedimentation of rivers, or even glacial lake outburst floods.

It seems commendable to link policies for hydropower development to vulnerability assessments of local river systems together with analyses of seasonal precipitation patterns including snow cover based on anticipated climate change scenarios. Consequently, responses to identified climate change risks could be included into project planning, maybe into the pre-feasibility studies of new hydropower projects as prescribed in the Bhutan Sustainable Hydropower Development Policy 2008 (MoEA 2008: 11), and climate risk assessment studies could be conducted for existing plants. These studies, amongst others, could assess impacts of changing river flows, flash

floods, and sedimentation on required discharge water for run of the river hydropower stations and on influx into water reservoirs of the large dam projects. Assessing the risks of glacial lake outburst floods (GLOFs) on the hydropower plant's operation and infrastructure, ultimately on its economic viability, could trigger increased support for risk reduction projects such as lowering the level of dangerous glacial lakes at the headwaters, building on the experiences of the Thorthormi glacial lake project.

Regarding food security, the Food and Nutrition Security Policy 2014 clearly refers to climate change as threat and recommends some adaptation options, yet the issue of food security and sustainable food production also needs to be linked to key challenges of the agriculture sector such as rural-urban migration, and decreasing smallholder farming requiring intensified government support to make farming more viable through mechanisation, market infrastructure, commercial farming, and rehabilitation of fallow land to enhance scarce arable farm land. On the other side, infrastructure development such as rural electrification, information and communication technologies services, road construction, primary schools, and basic health units is significantly improving living conditions in rural settlements. This creates more potential for remigration to rural Bhutan and, facilitated by government's incentives and technical support, enhance opportunities to take up modernised farming on favourable landscapes with integrated water and land management methods.

Furthermore, policies for food security and agriculture together with promotion for remigration to rural areas also could be linked to promotion of behavioural changes to specifically motivate educated youth to overcome the widespread social habit of attempting to join civil service rather than private entrepreneurship or farming.

Clear references to climate change are provided at the level of national action plans and technology needs assessments. The action plans on biodiversity and on low carbon development and the multi-sectoral technology needs assessments on climate change mitigation and adaptation have listed key cross-sectoral links which need to be further incorporated into sectoral strategies and implementation plans with specific interconnected points of contact, as important sectors like water resources, agriculture, forestry and biodiversity, energy, and human health are strongly

intertwined in their vulnerability to climate change (NEC 2011: 105). Examples are glaciers feeding river water resources for hydropower generation; forests and biodiversity dependent on precipitation enabling water resources like springs and rivulets used for irrigation of agricultural land relevant for food security, as well as for safe drinking water important for human health; agricultural biodiversity of more climate resilient native crops and livestock enhancing food security and preventing malnutrition relevant for human health; and the forest cover under environment protection securing carbon sequestration, basis for the political commitment to carbon neutrality of Bhutan.

Additionally, to fulfil the commitment to remain carbon neutral for all times “growing emissions from economic development will need to be mitigated by pursuing low emission development pathways across all sectors” (NEC 2015: 3). Especially for transport and industries, two economic sectors with major increase in emissions, low emission development strategies are planned to be developed (NEC 2016: Annex II: 4).

Solid groundwork for climate change adaptation planning has been laid under the lead of the National Environment Commission identifying detailed adaptation priorities for all sectors, as included in the 2011 Second National Communication from Bhutan to the United Nations Framework Convention on Climate Change (NEC 2011: 108-123). The upcoming process of formulating Bhutan’s first National Adaptation Plan (NAP), which is planned to be carried out latest by 2019, could include consolidated and integrated mitigation and adaptation priorities with all cross-sectoral linkages incorporated to formulate one key climate change reference document for all sectors, to be integrated into multi-annual development planning.

The political challenge remains to achieve a balance between sustainable socio-economic development and conservation of environment, two pillars of Bhutan’s development concept of gross national happiness.

8.5. History of development plans

The year 1961 marked the beginning of multi-annual development planning in Bhutan with the formulation of the first five-year plan and establishment of a separate development secretariat for implementation. Institutional arrangements were

strengthened ten years later in 1971 when the Planning Commission was created under the leadership of the king. After another decade the dzongkhag tshogdu as decentralised decision-making assembly at district level was established in 1981 for improved planning and review of local development measures. Again ten years later in 1991 decentralisation was extended to the level of counties by forming the gewog tshogde as county council with the main purpose to involve local government into implementation of development activities (NSB 2015: IX, 219). In 2008 the erstwhile Planning Commission was renamed as the Gross National Happiness Commission (GNHC) with the key mandate to ensure integration of the development concept of gross national happiness into all policies and plans.

While for earlier five-year plans detailed socio-economic data were not available, after the opening of the landlocked and secluded mountain country in the late twentieth century and the start of a modernisation process, the onset of the twenty-first century with the ninth five-year plan from 2002 to 2007 brought the focus on improvement of living conditions, development of private sector and employment, good governance, and preservation of environment and culture, reflecting the values of gross national happiness. To support these overall goals together with fast economic growth special attention was given to infrastructure development and social service delivery.

The ninth plan stipulated poverty alleviation as central theme of development as “income of people has remained low due to limited cultivable land holding, low productivity of land, poor access and lack of technical know-how” (PC 2003: 32). Moreover, the plan for the first time introduced a gewog based development planning process putting into practise the devolution of decision-making power to local governments (GNHC 2009: 3).

Regarding awareness of climate change the ninth development plan recognised that Bhutan is a net sink of greenhouse gases, and that disasters such as floods and landslides, triggered by climate change, bear the risk of enhancing poverty (PC 2003: 30, 34). The period of the ninth five-year plan was extended for one year until June 2008 to cover the political transition period of the year 2008 with the first parliament election and the first constitution adopted, and to start the new fiscal year from July 2008 onwards with the tenth plan under the new government.

The tenth five-year plan for the period from 2008 to 2013 again had declared poverty reduction as primary goal to achieve equitable socio-economic development, as stipulated in the concept of gross national happiness (GNHC 2009: 25). Local surveys unveiled that despite increasing economic growth poverty was still prevalent among about one fourth of Bhutan's residents predominantly in rural areas characterised by lack of social services, infrastructure, and employment. Consequently, the tenth plan promoted a more targeted pro-poor approach by development of agriculture and rural enterprises together with better access to markets, enhancing knowledge and technical skills, as well as construction of roads and electricity supply to remote villages in order to improve rural livelihoods (GNHC 2009: 25-26).

After successfully establishing a gewog based development planning process in the ninth plan devolution of authority to local governments was further strengthened by introducing fiscal decentralisation in the tenth plan providing allocated annual financial resources for implementation of local development activities (GNHC 2013a: 249).

Regarding climate change the tenth five-year plan recognised under concerns for development Bhutan's vulnerability to negative impacts of climate change such as flash floods and excessive rainfall triggering landslides, as well as glacial lake outburst floods with possible effects on the economic viability of hydropower plants (GNHC 2009: 86, 113). Hence, mitigation measures at dangerous glacial lakes were included under strategies, and the specific target was set for carrying out mitigation work at the Thorthormi glacial lake, together with installing early warning systems in the downstream valley (GNHC 2009: 110), which subsequently has been achieved in 2012 through the project under the National Adaptation Programme of Action (NAPA).

8.6. Local government structure for development planning

Political decentralisation has been strengthened in the context of the first written constitution of Bhutan adopted in 2008. This includes responsibility and accountability of local governments for planning and implementing development strategies and activities. "Power and authority shall be decentralized and devolved to elected Local Governments to facilitate the direct participation of the people in the development

and management of their own social, economic and environmental well-being” (The Constitution of the Kingdom of Bhutan 2008: 42).

Generally, local governments shall promote integrated development planning in the context of gross national happiness while providing democratic government structures for local communities (The Local Government Act of Bhutan 2009: 11). To implement local development activities and maintain local infrastructure, and to achieve their goal of service delivery to the people local governments receive annual grants from the national budget and are entitled to collect local taxes and fees (The Local Government Act of Bhutan 2009: 49).

At the level of the twenty dzongkhags (districts) of the country, administered by the dzongdags (governors) appointed by the king, the dzongkhag tshogdu (district assembly) is the highest decision-making body comprising gup and mangmi (elected head and deputy head) of all gewogs (counties) under the dzongkhag, plus the thrompon of the thromde (elected mayor of the city) and one elected representative of each yenlag thromde (satellite town) of the particular dzongkhag (The Local Government Act of Bhutan 2009: 3). To ensure socio-economic development the responsibility of the dzongkhag tshogdu is the finalisation of the dzongkhag five-year development plan to be endorsed by the central government, and approval and monitoring of subsequent annual plans within the allocated budget for implementation (The Local Government Act of Bhutan 2009: 12, 14).

Under the dzongkhag administration the dzongkhag planning officer (DPO) plays a key role in preparing development plans and coordinating with the gewogs. Officers are employed for the key sectors such as agriculture, livestock, forestry, health, and education, to implement sectoral policies and programmes. For that reason, the officers are technically accountable to their respective ministries. Dzongkhag education officers for instance support district schools, early childhood care and development (ECCD) centres, and non-formal education centres to increase the adult literacy rate. Health officers are responsible for the public health system in traditional and modern medicine, the health care centres, basic health units in remote settlements, and district hospitals. Furthermore, the dzongkhag sector officers coordinate and support the sector extension supervisors posted in the gewogs.

Agriculture, livestock, and forestry extension staff for instance operate from renewable natural resources (RNR) extension centres at the gewog level. Additionally, environment officers are positioned under the dzongkhag civil administration and cooperate with the National Environment Commission (Mongar 1).

In the 205 gewogs in Bhutan the gewog tshogde (county council) is the decision-making body comprising gup and mangmi of each gewog together with the tshogpas (elected representatives) of the chiwogs (clusters of villages) under the gewog. In terms of decentralised development planning the gewog tshogdu formulates the local five-year plan to be coordinated and approved by the dzongkhag, prepares the gewog annual plans and monitors implementation of development activities (The Constitution of the Kingdom of Bhutan 2008: 44; The Local Government Act of Bhutan 2009: 3, 16). A gewog administrative officer (GAO) assists the gup and gewog tshogde on local development planning and implementation in the gewog (MoHCA 2012: 79-80).

8.7. Local development planning process and social participation

In a consultative process involving planning officers of ministries and dzongkhags the Gross National Happiness Commission (GNHC) first drafted key result areas to be achieved by the eleventh five-year plan for the period 2013 to 2018, followed by bilateral consultations with ministries and autonomous agencies such as the Tourism Council of Bhutan, the Royal Civil Service Commission, and the Royal University of Bhutan. Subsequently, comprehensive consultations with the private sector, cabinet, and dzongdags were conducted (GNHC 2012: 2). Once GNHC had issued planning guidelines and final key result areas within the strategic framework of gross national happiness, together with the vision document Bhutan 2020 and the Economic Development Policy 2010, local government plans were prepared in all twenty dzongkhags following a consultative and participatory approach and gewog based planning process.

Social participation of communities in the planning process of the five-year plan and subsequent annual work plans is facilitated by the instrument of zomdus (community meetings) in the chiwogs, called by their elected representative, the tshogpa, to discuss development issues at the grass-roots level. All eligible voters of the chiwog are

required to participate in the zomdu, which needs to comprise a minimum of two-thirds of all registered gungs (households) to have a quorum, but only one person per gung is entitled to vote (MoHCA 2012: 34, 65).

If organised and moderated in a socially inclusive manner, supported by gewog administrative officers and technical advice by sector extension officers, zomdus can offer opportunities for all social groups within a chiwog to articulate their needs and aspirations, assess socio-economic realities, challenges and proposals, and to come up with local development priorities. Social inclusion also increases chances of stronger community ownership and advanced community involvement in implementation of the planned development activities. This participatory approach of involving local communities already in the planning phase “greatly enhances their capacity to take charge of their own development and contributes to sustainability” (GNHC 2014: 3). For instance, regular maintenance of community infrastructure such as irrigation pipes and channels or electric fencing against wild animals requires active community engagement.

Proposals, priorities and targets of local communities resulting from the zomdus of all chiwogs under a gewog then need to be discussed and prioritised at the gewog tshogde and included into the gewog development plan based on some preliminary technical considerations on feasibility and estimated budgets. Subsequently, all submitted gewog development plans are discussed, coordinated and prioritised at the dzongkhag tshogdu together with identified districtwide proposals from technical sectors and formulated as the dzongkhag development plan in line with national priorities and the budget allocated by the government. These dzongkhag development plans need to be reviewed by the Department of Local Governance under the Ministry of Home and Cultural Affairs, and then submitted to GNHC for consideration and finalisation of plan and budget at the national level. Finally, the consolidated five-year development plan of the country needs to be adopted by the parliament, and is then distributed via the dzongkhags to all gewogs of the country (MoHCA 2012: 51-52). During all these stages of plan preparation and finalisation the tshogpas are responsible to keep the local communities of their chiwogs informed (GNHC 2014: 26).

To facilitate proper mainstreaming and integration of opportunities and risks of the key cross cutting issues of gender, environment protection, climate change, disaster risk reduction, and poverty alleviation (GECDP) into the local development planning process of the eleventh five-year plan GNHC published a framework document to support local governments and sector officers during their plan formulation providing identified key concerns and options for the respective dzongkhags (GNHC 2013b). Additionally, the GECDP mainstreaming reference group, established as multi-sectoral technical group by the prime minister in 2013, conducted training workshops in four regions of Bhutan, namely the districts of Paro, Tsirang, Bumthang, and Mongar, with participation of gewog administrative officers and sector officials of all twenty dzongkhags (GNHC 2013b: 2).

9. Analysis of current development planning in the context of climate change: The Eleventh Five Year Plan 2013-2018

Main objective of the eleventh plan is to lay the groundwork for achieving self-reliance through a more diversified economy by 2020 and to promote inclusive and green socio-economic development through reduction of poverty and inequality and through pursuit of carbon neutral economic growth (GNHC 2013a: 111). Thus, contributing to mitigate climate change through controlled greenhouse gas emissions is embedded in the overall key planning objective of Bhutan's current five-year development plan.

9.1. National level

The eleventh plan, showing a paradigm change to earlier five-year plans, adopts a result based planning approach with overall outcomes identified as the key result areas for the national and district level, and for the particular sectors, which need to be achieved in order to realise the main objective of self-reliance and inclusive green socio-economic development. Altogether sixteen national key result areas identified during the plan preparation process are grouped under the four pillars of Bhutan's development concept of gross national happiness (GNH), which are good governance, sustainable socio-economic development, preservation of culture, and environmental conservation. Under the GNH pillar of environmental conservation the plan outlines

four national key result areas, all of them also relevant in the context of climate change mitigation and adaptation: carbon neutral (green) and climate resilient development, sustainable use of natural resources, water security, and improved disaster resilience (GNHC 2013a: 3-4, 13).

For the first national key result area (NKRA) of carbon neutral and climate resilient development key performance indicators are to keep greenhouse gas emissions controlled to remain below 6309.6 gigagrammes carbon dioxide (about 6.3 megatonnes), from a baseline of 1559.56 gigagrammes (about 1.56 megatonnes) in the year 2000; to upgrade the standards of measuring ambient air quality; and to keep public perception of ecological issues by sixty-nine percent of the population (baseline 2010) sustained or increased (GNHC 2013a: 117-118).

The second NKRA of sustainable use of natural resources has the key performance indicators of increasing the forest area under sustainable forest management practises from less than seven to twelve percent; conducting studies on measuring the ecological footprint of the country, comparing the availability of productive land to the amount of land used by the population; and of maintaining the population of tigers as a so called umbrella species, significant for the healthy status of an ecosystem, at 155 animals (GNHC 2013a: 118).

The third NKRA of water security is measured by achieving the key performance indicators of access to safe drinking water round the clock for all settlements of the country; maintaining ambient water quality and upgrading testing standards; and sustaining the mean annual flow of Bhutan's rivers mainly through improved watershed management (GNHC 2013a: 119).

And for the fourth NKRA of improved disaster resilience, under the GNH pillar of environmental conservation, key performance indicators are to establish disaster response teams well trained and equipped in all twenty dzongkhags, and to enable the teams to respond to disasters within two hours (GNHC 2013a: 119).

Furthermore, sustained food security is one of the national key results areas under the GNH pillar of sustainable and equitable socio-economic development, setting the target to enhance self-sufficiency in cereals from sixty-four percent in 2011 to seventy-

five percent, and to increase milk self-sufficiency from ninety percent in 2011 to one hundred percent. Additionally, the occurrence of stunting among children below the age of five years due to chronic malnutrition is planned to be reduced from 33.5 percent (baseline 2010) to less than thirty percent by the end of the eleventh plan period (GNHC 2013a: 114-115).

Regarding the climate relevance of these described national key results areas it is noted that, while promoting economic growth, the plan's target is to keep greenhouse gas emissions in any case below 6.3 megatonnes carbon dioxide, which corresponds to the estimated carbon sequestration capacity of the country's forests, thus safeguarding Bhutan's commitment to carbon neutrality. Promoting sustainable forest management will support to keep the vast forest cover intact and is important to enhance water security by protecting mountain water sources, as climate change causes changing precipitation patterns and prolonged dry seasons. Furthermore, enhancing food production, best together with developing climate resilient farming practises, is essential for food security and also relevant for food storage and distribution in the context of disaster management. Finally, enhancing disaster preparedness and resilience of communities through trained and equipped local disaster response teams is essential in times when climate change is expected to even exacerbate natural disasters.

The eleventh plan's observation of adverse climate change impacts also highlights the health sector with increasing cases of malaria in higher areas due to warming temperatures, and the agriculture sector prone to natural hazards intensified by climate change like flash floods, landslides, and droughts, together with negative factors such as rural-urban migration, decreasing smallholder farming and arable land, and poor agricultural production and management practices (GNHC 2013a: 153, 170, 190, 195).

By incorporating the target of economic self-reliance, as laid down in the Economic Development Policy of the Kingdom of Bhutan 2010, the aim for Bhutan's future development is to graduate from the status as Least Developed Country (LDC) by the year 2020. Apart from already achieved and further projected economic development, this intention includes the necessity of significant improvements in the area of human

assets such as high children malnutrition and mortality rates of children under the age of five years, and the low literacy rate among adults; and in the area of economic vulnerability of the small landlocked country with a small-sized population, characterised by low industrial and agricultural production, high dependence on imports, and vulnerability to disasters (GNHC 2013a: 4-5).

As of 2015 Bhutan has also achieved eligibility for LDC graduation in the area of human assets by successfully reducing malnutrition and mortality rates of children under five years, leaving the area of economic vulnerability as challenge for the next five-year plan period from 2018 to 2023 (GNHC 2016: 3-4).

Challenges, objectives and strategies, based on the analysis of the current situation of the country, are outlined in the first volume of the eleventh plan document for the planning period 2013 to 2018, mentioning climate change as a significant driver of change for the country's sustainable socio-economic development intentions.

9.2. Sectoral level

Breaking down the national key result areas into sectoral key result areas, the second volume of the eleventh plan describes more detailed the planned development programmes of the sectors, which, under the lead of ministries and central agencies, are to be implemented in cooperation with local governments. Subsequently, sectoral programmes are selected and analysed on their relevance for climate change mitigation and adaptation.

Renewable natural resources (RNR) sector

Under the responsibility of the Ministry of Agriculture and Forests, several programmes of the RNR sector are relevant in the context of climate change. The National Field Crop Commodity Development Programme includes under its strategies strengthening of research on crop species more resilient to biotic stresses such as pest and diseases, and abiotic stresses caused by changing temperatures, floods or droughts, all exacerbated by climate change (GNHC 2013c: 9-10). Successful research and cultivation of climate resilient crops can contribute to adapting farming practises to climate change, and moreover, to food security and improvement of rural livelihoods reducing rural-urban migration.

The National Horticulture Commodity Development Programme aims at enhancing production of vegetables, fruits, nuts, mushrooms, and medicinal, aromatic and spice plants to increase self-sufficiency in these commodities and support rural incomes through diversification. General risks of climate change are mentioned but no specific adaptation strategies articulated (GNHC 2013c: 13-17). However, if sustainable farming methods are planned, enhancement of agro-biodiversity also contributes to a more climate resilient agriculture.

The Agriculture Infrastructure Development Programme aims at the necessary improvement of the irrigation infrastructure, as existing irrigation systems usually are inefficient due to inappropriate construction methods and poor maintenance, leading to low yields of agricultural crops. Therefore, continued building and improved maintenance of efficient irrigation and water storage systems for enhanced production of cereals and horticulture crops, especially for commercial farming, is required (GNHC 2013c: 18). Although climate change is not mentioned in the programme, efficient irrigation and water harvesting and storage can increase sustainability of farming in times of water shortage, droughts, and changing weather and precipitation patterns due to climate change. Furthermore, increased crop yields contribute to food security and improvement of rural livelihoods reducing rural-urban migration.

Promoting and supporting adoption of organic farming methods, still in their initial stage in Bhutan, is planned under the National Organic Development Programme. Organic agriculture improves soil conditions and sustainable use of natural resources and can contribute to diversified rural livelihoods, especially in remote areas and within national parks, through further processing of organic products. The programme aims for increase of organic crops and livestock production and organic management of pest and diseases (GNHC 2013c: 21-23). Although climate change is not mentioned in the programme, protection of natural and agricultural biodiversity is relevant for strengthening climate resilient agriculture. In terms of climate change mitigation, organic farming increases the carbon sequestration capacity of soils while reducing carbon emissions from soils treated with chemical fertilisers (Bio-Agriculture 1). Moreover, organic farming contributes to food security and better health through nutritious and residue-free food.

The National Livestock Commodity Development Programme puts the promotion of green livestock farming in the context of climate change, specifically the promotion of biogas plants among rural households (GNHC 2013c: 27), substituting fossil fuel use. In general, the programme's goal is to increase domestic livestock production, including improvement of livestock breeds, to enhance self-sufficiency in view of local demand and high dependency on imported meat and livestock products (GNHC 2013c: 24-28). Biogas plants are a locally suitable technology to diversify alternative renewable energy sources and to reduce use of fossil fuels, thus contributing to climate change mitigation through reduction of carbon emissions. Relevant for climate change adaptation could be the planned improvement of livestock breeds, if considered in the context of agricultural biodiversity, as genetic diversity of native livestock offers better opportunities for breeding of more climate resilient species than the reduced variety of introduced imported breeds, as outlined in the National Action Plan Biodiversity Persistence and Climate Change 2011 (NBC 2011: 18-19).

It is noted that the programme's description is not referring to popular constraints for domestic meat production due to religious beliefs based on the refusal of killing animals. Nevertheless, national meat consumption is on the rise and the huge majority of meat and livestock products are imported. Increased livestock production also strengthens food security and improves rural livelihoods reducing rural-urban migration pressure.

Similarly, with focus on the high altitude rangelands, the Targeted Highland Development Programme aims for support of traditional herding practices and livestock production, mainly of yaks, together with value addition to yak products, in order to increase livelihoods of nomadic and semi-nomadic communities. Additionally, of strategic political importance is the presence of herder communities in the mountain peripheral regions to contribute to the integrity of the otherwise sparsely populated borderland. Climate relevant targets are the promoted alternative renewable energy sources such as solar lights and biogas plants, mentioned as climate smart technologies, but also the envisaged protection of biodiversity and sustainable management of rangelands and watersheds (GNHC 2013c: 29-31).

The Biodiversity Conservation Programme's goal is to conserve local variety of genetic resources, specifically in view of new crops and livestock species introduced to achieve higher agricultural productivity, yet, with the possibility of superseding local species. For this purpose, ex-situ and on-farm conservation of native crops and animal breeds, and enhancement of the National Gene Bank is intended, together with documentation of traditional knowledge on biological resources. The programme refers few times to climate change, namely to resilience to climate change together with food security, as envisaged achievement of conserving biodiversity; and to enhancement of climate change adaptation capacity of local communities through training, adoption of resilient crops in selected sites, and establishment of community seed banks (GNHC 2013c: 41-43).

Actually, the National Biodiversity Centre (NBC) is mandated with biodiversity conservation, including the National Gene Bank; however, this biodiversity conservation programme is under the responsibility of the agriculture ministry's secretariat. NBC, established in 1998 as non-departmental agency after Bhutan had ratified the Convention on Biological Diversity in 1995, obviously experiences lacking human and technical resources for the increasing tasks of coordinating biodiversity conservation and sustainable use of the country's biological resources. The programme's description includes the aim to enhance institutional capacity and upgrade the status of NBC (GNHC 2013c: 41).

Human settlement and housing sector

Under the Ministry of Works and Human Settlement, the Enhancing Human Settlements in Bhutan Programme recognises the need for improved settlement and spatial planning, and for balanced regional development. The programme also intends to adopt technologies for disaster resilient housing construction (GNHC 2013c: 77-78). Implementation of appropriate and affordable technologies would also contribute to climate change adaptation in view of the increasing number and magnitude of natural disasters. Of additional importance is the implementation of earthquake resilient construction methods, as Bhutan is located in the Himalayan region which is highly seismic active and extremely prone to major earthquakes.

Construction sector

Equally under the Ministry of Works and Human Settlement, the construction sector includes the programme called Engineering Adaptation for Disaster Risk Reduction aiming at reducing the vulnerability to floods and other natural disasters, specifically in view of environmental degradation and climate change. Research on appropriate technologies and construction of infrastructures for flood prevention are planned, together with risk assessments and publication of maps and plans (GNHC 2013c: 86-87). Flood risk reduction is highly relevant for adaption measures, as climate change is expected to increase the occurrence of flash floods and the risks of glacial lake outburst floods.

Geology and mines sector

Geo-scientific studies and risk assessment of geo-hazards is the programme's name implemented by the Ministry of Economic Affairs. The country is vulnerable to geological hazards such as floods and landslides, potentially exacerbated by climate change, and earthquakes caused by tectonic conditions. To mitigate and manage these risks planned activities include scientific studies, risk assessments, mapping of landslide areas, development of seismic risk maps, and installation of earthquake monitoring stations. To particularly mitigate glacial lake outburst floods induced by climate change monitoring and validation of glaciers and glacial lakes are part of the programme (GNHC 2013c: 104-105). Disaster risk reduction is highly relevant for adaption measures, as climate change is expected to increase the occurrence of natural disasters.

Hydropower, renewable energy and hydro met sector

The Ministry of Economic Affairs also is in charge of the programme Enhancing Hydrological Network for Water Resources Assessment and Improvement of Flood Information/GLOF Early Warning System. Aiming for enhancement of mitigation and management of climate change induced natural disasters such as floods, landslides, and droughts the programme stipulates expansion and modernisation of hydrological and flood warning stations with countrywide coverage (GNHC 2013c: 121-122).

Disaster risk reduction is highly relevant for adaptation measures, as climate change is expected to increase the occurrence of natural disasters.

Similarly, the programme Strengthening Meteorological Network Coverage and Enhancing Weather and Climate Information Services shall meet the demand for timely and forecasting information on weather and climatic conditions, and provide climate data for modelling of climate change scenarios. For this purpose, the current inadequate observation coverage will be upgraded to a countrywide meteorological monitoring network, together with public information and media advocacy activities (GNHC 2013c: 125-126). Implemented as well by the Department of Hydromet Services under the Ministry of Economic Affairs, the meteorological network will be developed in alignment with the hydrological network and flood warning stations, and will contribute to disaster risk reduction in the context of climate change.

Energy sector

Under the lead of the Ministry of Economic Affairs, the programme called Promotion and Development of Renewable/Alternate Energy Technologies is formulated to broaden the mix of renewable energy sources in view of rising domestic demand and growing imports of fossil fuels, and increasing reliance on hydropower as main energy source of Bhutan. Promoting renewable energy sources like solar and wind power, biomass, and small hydropower plants, and creating an enabling environment for investors through feasibility studies are pursued strategies of the programme.

Working towards the minimum target of generating twenty megawatts (MW) mainly from solar power, wind, and biomass by 2025, as stipulated in the Alternative Renewable Energy Policy 2013 (RGoB 2013: 6), a solar power plant with one MW capacity, a 360 kilowatt wind power plant, and a biomass power plant with ten kilowatt as a smaller size model for rural communities are planned to be installed under the programme, together with a significant increase of the number of biogas plants, solar water heating systems, and energy efficient cook stoves. Additionally, rural electrification will be complemented by installation of solar photovoltaic system systems for 300 remote households (GNHC 2013c: 136-140).

Climate change is not mentioned in the programme's description, although the development of alternative renewable energy sources directly contributes to mitigate climate change through reduction of fossil fuel use in rural Bhutan such as kerosene and firewood, hence reducing carbon emissions.

Trade sector

Also under the Ministry of Economic Affairs, the Strengthening Trade Policy and Regulatory Framework programme includes one strategy component to import higher quality fuel with lower emissions. For this purpose, the Bhutanese government needs to negotiate with the Indian government and oil companies on the import of fuels complying with higher emissions standards, and establish adequate testing facilities (GNHC 2013c: 146-148).

Though not specified as climate relevant activity in the plan, reduction of carbon emissions from fossil fuel use in public and private traffic will not only reduce air pollution, but is part of the mitigation efforts of Bhutan as a carbon neutral country.

Industry sector

The programme named Promotion of sustainable and environment friendly industrial development, as well under the Ministry of Economic Affairs, aims at supporting diversification of industries, as Bhutan's industrial growth is mainly driven by hydropower and construction, and few mineral and metal production companies in southern Bhutan. While working to broaden the economic basis in a sustainable way green industries are promoted with low carbon emission technologies. Furthermore, a waste management facility is planned to be built at the industrial zone of Pasakha near the main commercial town of Phuentsholing at the southern border with India (GNHC 2013c: 157-159).

Climate change is not mentioned in the programme's description, although reduction of industrial and waste emissions directly contributes to mitigate climate change, essential in developing a low carbon society.

Transport and communication sector

The programme under the Ministry of Information and Communications is called Expansion and Strengthening of Air Transport, however, the focus surprisingly lies on

exploring alternative public transport means such as ropeways, water ways, railways, electric public transport systems, and construction of bicycle tracks. Apart from a remark on promoting environment friendly surface and air transport plus controlling their emissions by planned emission testing facilities, a bundle of measures shall strengthen road safety and deficient traffic discipline. Furthermore, enhancing urban and inter-district public transport services appears on the agenda of the programme (GNHC 2013c: 174-179).

The programme has no explicit reference to climate change. However, alternative transport facilities will reduce carbon emissions from fossil fuel use in public and private traffic, thus contributing to mitigate climate change through low carbon pathways for development.

Education sector

Under the lead of the Ministry of Education, the programme Access and Sustainability of School Education aims at providing general access to education through further improvement of school infrastructure and management of the education system. Additionally, preparedness for and response to natural disasters shall be strengthened by providing all schools with disaster responsiveness plans and by using disaster resilient technologies for new construction of educational buildings. Assessment and construction measures for existing schools to improve their disaster resilience are also mentioned in the programme (GNHC 2013c: 197-200).

Although climate change is not mentioned in the programme, upgrading of all educational infrastructures to improve disaster resilience enhances safety of children, students, and faculty, thus contributing to increase the country's adaptive capacity to climate change as well, especially in view of the rising number and magnitude of climate change induced natural disasters. Of additional importance is the implementation of earthquake resilient construction methods, as Bhutan is located in the Himalayan region highly seismic active and extremely prone to major earthquakes.

Complementing access to education with improving quality standards of education is the main goal of the programme Relevance and Quality of School Education. Among the planned activities enhancement of environmental education and promotion of

green initiatives in all schools are included (GNHC 2013c: 201-203). There is no specific reference to climate change in the programme, but in case environmental education incorporates climate change in its curriculum, general awareness and knowledge on climate change impacts can be enhanced.

This can be achieved in alignment with the programme Curriculum Research and Development, originally planned under the Department of Curriculum Research and Development (GNHC 2013c: 204-206). However, as informed by the 2015 annual report of the prime minister, the Department of Curriculum Research and Development under the Ministry of Education has been incorporated under the autonomous Royal Education Council to ensure independent research and curriculum development for Bhutan's education system (Tobgay 2015: 22).

Health sector

Under the Ministry of Health, the Medical Services programme's goal is to improve general quality and specialisation of medical services and to increase access to health care especially for remote communities. Relevant for improved disaster resilience, also in the context of climate change, is the planned strategy of enhancing overall emergency and disaster preparedness through the programme components of assessing district hospitals and basic health units on their structural disaster resilience, building new health infrastructure using disaster resilient technologies, and introducing trainings on emergency and disaster response for health workers and regular drills for hospital staff (GNHC 2013c: 245-254).

The Traditional Medical Services programme aims at enhancing health services of traditional medicine integrated into the national modern health care system while conserving traditional knowledge and cultural heritage. Key programme activities are institutionalisation of quality control and standardisation of production of herbal medicine devices and enhancement of scientific research capacities on traditional medicine including development of new medicinal products. Furthermore, upgrading qualification of menpas (traditional healers) will help protecting people from harmful practises of quacksalvers. Additional income for improving rural livelihoods can be achieved through sustainable collection of raw materials, herb gardens, and cultivation of endangered medicinal plants (GNHC 2013c: 255-258).

Contributions to conservation and sustainable use of the country's rich biodiversity also can be considered as mitigation measure to climate change due to the sequestration of greenhouse gases.

The Public Health Services programme's capacity building for risk assessment and response to public health events also includes monitoring of climate sensitive health risks and emerging diseases due to climate change such as spreading of tropical diseases like dengue fever and malaria, with a focus on sustained malaria prevention and control. Furthermore, strengthening of nutrition initiatives at community level, improving nutritious diet for mothers and children and promoting breastfeeding for the first six months, increasing reproductive and child health services, and raising the use of contraceptives are targets under the programme (GNHC 2013c: 268-279).

Not least better health hand in hand with improved access to safe drinking water and sanitation facilities are supporting factors of poverty alleviation and also strengthen adaptive capacity of people to negative impacts of climate change.

Environment sector

Under the Ministry of Agriculture and Forests the Sustainable Management of Forest Landscapes and Conservation of Biodiversity programme aims at minimising pressure from economic development activities on natural resources, and improving management and security of protected areas and biological corridors. Cited strategies are protecting endangered and endemic species, conserving designated biodiversity areas and heritage forests, and promoting sustainable use of resources by local communities. Furthermore, development of community based ecotourism activities within and around national parks and reduction of human wildlife conflict incidences are on the programme's agenda (GNHC 2013c: 329-333).

Negative impacts of climate change on nature systems are generally stated under the programme's risk assessment. However, not mentioned in the programme is the core contribution of sound forests and biodiversity areas to mitigate climate change through their carbon sequestration capacity.

The Sustainable Management of State Forests programme's goal is to ensure the forest cover of at least sixty percent of the country as mandated by Bhutan's constitution,

while enabling sustainable use of timber and non-wood forest products for local communities and commercial activities. A national forest inventory is planned to be conducted together with establishing a forest database and assessing the countrywide carbon sink capacity. Furthermore, improving wood based processing technologies and value addition to non-wood forest products, supporting scientific environmental and forestry studies, and enhancing the number of community forest groups for increased social participation in sustainable forest management practises are planned (GNHC 2013c: 334-337).

This programme is essential for Bhutan's main climate change mitigation activities through the carbon sequestration by the national forests, in line with the political commitment to remain a carbon neutral country.

Another important environment sector programme under the Ministry of Agriculture and Forests is called Integrated Watershed Management to ensure Sustainable Environmental Services. Watersheds are crucial for continuous supply of water as the country's key natural resource for forests, biodiversity, agriculture, human settlements, industries, and hydro-electricity generation. Among the planned activities are establishing integrated watershed management practises for river systems and wetlands in close cooperation with dzongkhags and gewogs, afforestation in degraded forest areas, and conducting research on water resources and forestry in the context of climate change.

Moreover, the programme includes the development of a national strategy for reducing emissions from deforestation and forest degradation, including conservation and enhancement of forest carbon stocks, together with sustainable forest management. The mechanism for reducing emissions from deforestation and forest degradation in developing countries (REDD+) under the United Nations Framework Convention on Climate Change (UNFCCC) can offer opportunities for additional external funding from industrialised countries to compensate for their own carbon emissions by financing efforts of preserving forest carbon stocks in developing countries. Linked to the national key result area of water security this watershed programme significantly contributes to climate change mitigation (GNHC 2013c: 338-341).

Under the lead of the Department of Disaster Management of the Ministry of Home and Cultural Affairs, the programme Enhanced Disaster Preparedness, Response and Relief Capacity deals with the high risks of natural disasters in Bhutan. To reduce disaster risks the programme contains development of disaster resilient technologies for infrastructure, formulation of plans and establishment of committees and training activities for disaster management, and composition of disaster response teams in all twenty dzongkhags. Additionally to climate change induced natural disasters such as glacial lake outburst floods (GLOFs) due to global warming and glacier melt, severe disasters can be caused by earthquakes, as Bhutan is part of the Himalayan region, highly seismic active and extremely prone to major earthquakes (GNHC 2013c: 342-345).

Under the lead of the National Environment Commission (NEC), the programme Conservation and Sustainable Environmental Management aims at developing and implementing environmental policies and legislation, and mainstreaming of environment into policies and programmes of all sectors. Formulating a strategy for climate resilient and carbon neutral development and preparing the National Adaptation Plan (NAP) are key elements of NEC's policy development for the eleventh plan period. Under the United Nations Framework Convention on Climate Change (UNFCCC) the Third National Communication from Bhutan as reporting obligation on climate change is due in 2016. Moreover, standards for air and water quality and standards for vehicle emissions will be upgraded. Water security is given special priority with measures such as developing an integrated water resource management plan and conducting a countrywide inventory for water resources. Furthermore, NEC plans to establish minimum environmental flows for all rivers with hydropower plants and projects (GNHC 2013c: 346-353).

Due to the prevalence of hydropower as the country's key energy source the natural flow of rivers with changing water levels is disrupted by hydropower plant constructions, especially by water reservoirs and dams. To sustain sufficient supply of freshwater for ecosystems, fish and wildlife, and downstream agriculture and human settlements, the required minimum flow level of rivers needs to be determined and

adequate release ensured through long-term water management practises, called environmental flows (International Rivers 1).

Review observations

In this analysis of sectoral programmes of the eleventh five-year plan on their relevance for climate change mitigation and adaptation, agriculture, forests, and water have turned out as key and strongly intertwined areas for socio-economic development in Bhutan. Although not always reflected, all three areas are highly vulnerable to adverse climate change impacts and have significant relevance for climate change mitigation and adaptation, together with the objective of improving disaster resilience.

Agriculture including livestock provides livelihood for about fifty-seven percent of the population of a mainly agrarian society and contributes to food security of the country, complemented by the rich biodiversity and large forests providing timber, herbs, berries, mushrooms, medicinal plants, and other non-wood forest products. Sustained rural livelihoods secure vital communities, preservation of cultural traditions, and pastoral economy in borderlands. Moreover, forests and biodiversity protect sound watersheds for mountain springs and wetlands, crucial for mountain communities and agricultural irrigation in the steep terrain of the rugged country. Only in few wider valleys in central and western Bhutan, and the strip of foothills and plain land along the southern border, rivers fed from the Himalayan glaciers can be used for irrigation. Furthermore, rivers are the source for hydropower as key renewable natural energy source and the main driver for economic growth due to substantial export of hydro-electricity to India.

Large forests secure carbon sequestration above domestic greenhouse gas emissions, key component of climate change mitigation together with low carbon pathways for economic development of a country which has committed to remain carbon neutral. Alternative renewable resources can partly replace fossil fuel use, reducing carbon emissions and contributing to mitigation. Hydropower ensures domestic green energy use while its export offsets carbon emissions in the importing neighbour country of India with its growing hunger for energy.

9.3. Local level

While sectoral development programmes, coordinated by ministries and central agencies, already require close collaboration of local governments at dzongkhag and gewog level for successful implementation, the third volume of the eleventh five-year plan outlines the development programmes of the local governments of all twenty dzongkhags, which then are reflected in the particular gewog plans of each dzongkhag for practical local implementation. As final part of the Eleventh Five Year Plan 2013-2018 analysis the twenty dzongkhag development plans are reviewed on their inclusion of climate change mitigation and adaptation measures, with special focus on the key climate relevant areas of agriculture, forests, and water, together with disaster management.

Apart from the national key result areas as overall guiding structure of the current development planning, and the sectoral key result areas guiding the planned development programmes of the sectors, each of the twenty dzongkhags has dzongkhag key result areas (DKRAs), grouped under the four gross national happiness (GNH) pillars of sustainable socio-economic development, cultural preservation, environmental conservation, and good governance. At the same time, the identified key climate relevant areas of agriculture, forests, and water, and also disaster management are reflected in the DKRAs, added in parentheses below.

The three DKRAs under the first GNH pillar of socio-economic development are enhanced rural household income and food sufficiency, focusing on increased food production (agriculture); improved health status of communities, and health care facilities and services; and improved quality of urban life, and basic infrastructure and services. Under the GNH pillar of cultural preservation the DKRA is preservation and promotion of traditional and cultural heritage. The DKRA of enhanced sustainable use and conservation of natural resources (forests, water) comes under the GNH pillar of environmental conservation. And the DKRA of improved quality of public service delivery (disaster management) belongs to the GNH pillar of good governance.

Unlike the more decentralised planning of local activities of different sectors by the local governments, activities of the education sector at dzongkhag level are centrally planned, coordinated and financed by the Ministry of Education to ensure equal access

of all children and quality of education services (GNHC 2013a: 250). Regarding climate change and environment, educational activities such as debates, quizzes, and competitions to raise awareness and increase knowledge are promoted in schools (e.g. GNHC 2013d: 44).

Generally, construction and maintenance of farm roads and irrigation channels are regular measures in all dzongkhags, as improved accessibility of settlements and water supply for irrigation are among the basic development requirements of rural communities. Agricultural activities mostly aim at enhancing agriculture and livestock productivity and food self-sufficiency through multiple measures such as training for farmers, marketing, cold storage facilities, and usually distribution of high-yield variety seeds and livestock breed improvement.

Agriculture

Organic farming, apart from its values of environmental friendliness, improved soil conditions and nutrient-rich and non-contaminated food production, is also relevant in the context of climate change by increasing the carbon sequestration capacity of soils, while reducing carbon emissions from soils treated with chemical fertilisers (Bio-Agriculture 1). Still in its initial stage in Bhutan, organic agriculture is promoted by the National Organic Development Programme, one of the sectoral programmes of the Ministry of Agriculture and Forests. At district level, trainings for farmers on organic agriculture are included in the local development plans of nine dzongkhags, namely Dagana, Paro, Pemagatshel, Samdrup Jongkhar, Samtse, Trashigang, Trongsa, Wangdue Phodrang, and Zhemgang, while in Thimphu the development of a model organic farm is part of the plan (GNHC 2013f: 17; GNHC 2013k: 18; GNHC 2013l: 23; GNHC 2013n: 25; GNHC 2013o: 21; GNHC 2013r: 25; GNHC 2013t: 23; GNHC 2013v: 24; GNHC 2013w: 26; GNHC 2013q: 15).

Sustainable land management (SLM) is one approach to maintain soil productivity and combat land degradation and deforestation, thus contributing to carbon sequestration, and to enhance the resilience of agricultural and ecological systems. Fifteen out of twenty dzongkhags have land management activities included in their plans, such as trainings on SLM and soil nutrient management (like green manuring, intercropping and mixed cropping), or land terracing, reclamation of degraded land,

and enhancement of area under land management, namely Chukha, Dagana, Mongar, Pemagatshel, Punakha, Samdrup Jongkhar, Samtse, Sarpang, Trashigang, Trashiyangtse, Trongsa, Tsirang, Wangdue Phodrang, and Zhemgang, and Bumthang plans leasing of barren land under government property to farmer's groups for pasture development, as well as pasture management for Yak herders in the highlands. Samdrup Jongkhar and Trashigang specifically promote sloping agriculture land technology (SALT) to prevent soil erosion through planting of hedgerows as natural barriers along steep fields, thus maintaining soil fertility and increasing crop yields. Trongsa additionally supports development of an agro-forestry model farm in all gewogs, also considered to be an adaptation technology by combining agriculture with planting of trees to prevent soil erosion and land degradation and to conserve soil fertility (GNHC 2013e: 23; GNHC 2013f: 17; GNHC 2013j: 25, 30; GNHC 2013l: 25; GNHC 2013m: 19; GNHC 2013n: 26; GNHC 2013o: 21; GNHC 2013p: 24; GNHC 2013r: 25-26; GNHC 2013s: 21; GNHC 2013t: 27, 29; GNHC 2013u: 22; GNHC 2013v: 24; GNHC 2013w: 24; GNHC 2013d: 31).

In the context of conserving agricultural biodiversity only in Bumthang preservation of local seeds of wheat, barley, and buckwheat in all gewogs is included in the dzongkhag plan (GNHC 2013d: 16).

Irrigation of agricultural land becomes a key issue in times of climate change induced aggravated water scarcity problems such as droughts and changing weather and precipitation patterns. Forests and biodiversity areas depend on precipitation to bear water sources like springs and rivulets used for irrigation of agricultural land in the hilly and mountainous regions. Less precipitation in winter has impacts on water availability for rural households and agricultural irrigation. Hence, efficient irrigation systems together with water harvesting and storage can increase sustainability of farming while adapting to climate change, apart from the necessary improvement of existing inefficient irrigation infrastructure in Bhutan due to inappropriate construction methods and poor maintenance. Sprinkler and drip irrigation systems enable continuous and efficient watering of fields with reduced water consumption. Promotion respectively installation of these technologies is intended in the local development plans of eight dzongkhags, namely Dagana, Paro, Pemagatshel, Samdrup

Jongkhar, Sarpang, Trashigang, Wangdue Phodrang, and Zhemgang (GNHC 2013f: 18; GNHC 2013k: 20; GNHC 2013l: 22; GNHC 2013n: 29; GNHC 2013p: 23; GNHC 2013r: 24; GNHC 2013v: 26; GNHC 2013w: 24, 28).

Rain water harvesting also enhances efficiency of irrigation during times of low water availability. Rain water harvesting technology for irrigation of backyard gardens of rural households is planned to be demonstrated in southeastern Samdrup Jongkhar, while southwestern Samtse plans construction of rain water harvesting equipment for vegetable production in the winter season (GNHC 2013n: 28; GNHC 2013o: 22).

Biogas plants are increasingly used by smallholder farmers in Bhutan. Biogas is produced through anaerobic digestion of livestock manure, reducing methane emissions, and substituting fossil fuel use such as kerosene and firewood in rural communities, hence reducing carbon emissions. Additionally, the residue of biogas plants is used as natural fertiliser. Also promoted by the Alternative Renewable Energy Policy 2013 to further diversify energy sources and to reduce domestic use of fossil fuels, countrywide upscaling of installing biogas plants is an applicable measure for climate change mitigation through reduction of greenhouse gas emissions. Pursuing this goal, the local development plans of seven dzongkhags, namely Dagana, Lhuentse, Paro, Samdrup Jongkhar, Trashigang, Trongsa, and Wangdue Phodrang, include the target to increase the number of rural households with installed biogas plants (GNHC 2013f: 30, 33; GNHC 2013i: 23; GNHC 2013k: 32; GNHC 2013n: 46; GNHC 2013r: 41; GNHC 2013t: 39; GNHC 2013v: 37).

Forests

Preserving forests contributes to protect catchment areas of spring water sources essential for drinking water, livestock, and agriculture. Moreover, the extensive forest cover is Bhutan's main asset for mitigating climate change through carbon sequestration. Regulated by the Forest and Nature Conservation Act of Bhutan 1995 and in line with Bhutan's constitution from 2008 to keep at least sixty percent of the country under forest cover and to support decentralisation and social participation in forest management, rural communities obtain rights and responsibilities for the use and management of designated forest areas owned by the government. As of 2014,

25,663 households were engaged in 600 community forests with a total area of 66,934 hectares (669.3 square kilometres, 258.4 square miles) (GNHC 2015: 5).

Consequently, the instrument of community forestry is given high priority in the local development plans of all twenty dzongkhags. Trainings for community forest (CF) groups and increase of the number of CF groups and the area under CF management are countrywide targets for the eleventh five-year plan. Apart from manifold afforestation and plantation initiatives, there is also widespread support for private forests and establishment of forest nurseries (GNHC 2013d: 21-24; GNHC 2013e: 22-23; GNHC 2013f: 24; GNHC 2013g: 22; GNHC 2013h: 19-21, 44; GNHC 2013i: 13, 19; GNHC 2013j: 22, 29; GNHC 2013k: 13, 23; GNHC 2013l: 21, 30; GNHC 2013m: 16; GNHC 2013n: 23; GNHC 2013o: 26, 29; GNHC 2013p: 20; GNHC 2013q: 13; GNHC 2013r: 20, 28-31; GNHC 2013s: 23-24; GNHC 2013t: 18, 27; GNHC 2013u: 24; GNHC 2013v: 21, 29-30; GNHC 2013w: 21).

Additional emphasis in all twenty dzongkhags is placed on a variety of non-wood forest products (NWFPs) for sustainable utilisation of natural resources. Trainings for farmers, support for NWFPs group formation and management, and promotion of sustainable harvesting, plantation and processing of NWFPs are measures to preserve biodiversity and to improve rural livelihoods through income diversification. Some of the dzongkhag plans also mention specific examples of NWFPs, for instance Gasa, Bumthang, Mongar, and Thimphu promote sustainable harvesting of cordyceps (*Ophiocordyceps sinensis*; Bhutan: yartsa goenbub), the parasitic caterpillar fungus growing in the highlands fetching high prices as traditional medicine and natural aphrodisiac. Orchids are promoted in Gasa, Mongar, and Paro, while increase of mushroom production is planned in Bumthang and Thimphu, especially the savoury and costly Matsutake mushroom (*Tricholoma matsutake*). In the milder climate of Paro, Samtse, and Sarpang bamboo and cane plantations are promoted for a variety of products. Aromatic or incense plants, mentioned in the plans of Gasa, Mongar, Paro, Sarpang, and Thimphu, can be used for production of essential oils or incense sticks. Finally, medicinal plants for traditional medicine products are preferred among high value NWFPs, either from collection of wild growing plants or from plantations. While medicinal plants are generally mentioned in Gasa and Trongsa, the plans of Lhuentse

and Wangdue Phodrang highlight amla fruits, also called amalaki (Indian gooseberry; *Emblica officinalis*), rich in antioxidants and favoured in Asian traditional medicine (Himalaya 1), and the Samdrup Jongkhar plan notes medicinal plants such as Chirata (*Swertia chirayita*), Satuwa (*Paris polyphylla*), and Rubia (*Rubia cordifolia*), also used for red dye powder (GNHC 2013d: 22-23; GNHC 2013e: 22; GNHC 2013f: 14, 23; GNHC 2013g: 14; GNHC 2013h: 13; GNHC 2013i: 11, 13; GNHC 2013j: 22; GNHC 2013k: 16; GNHC 2013l: 21; GNHC 2013m: 16; GNHC 2013n: 23; GNHC 2013o: 26, 28; GNHC 2013p: 17; GNHC 2013q: 13; GNHC 2013r: 20, 31; GNHC 2013s: 19; GNHC 2013t: 18, 27-28; GNHC 2013u: 20; GNHC 2013v: 21, 29; GNHC 2013w: 21).

Water

Bhutan's water sector is vulnerable to climate change, as springs, rivers, and ponds are mainly snow and rain fed, thus depending on glaciers, snow cover, and seasonal rainfall, as well as on forests. Protecting mountain water springs for drinking water and agricultural irrigation and managing the wider water catchment areas, or watersheds, linked to conservation of soil, biodiversity, and forests, are crucial for maintaining water supply and water quality for rural settlements and urban areas. Hence, protection of water sources is a key intervention area in all twenty dzongkhags. Supporting the gewogs in protecting local spring sources for instance through tree plantation and fencing, developing plans and conducting trainings on watershed management, and increasing watershed areas under management are primarily planned measures (GNHC 2013d: 23-24; GNHC 2013e: 23; GNHC 2013f: 14, 23; GNHC 2013g: 14, 22-23; GNHC 2013h: 13, 19; GNHC 2013i: 13, 18; GNHC 2013j: 22, 30; GNHC 2013k: 13; GNHC 2013l: 21, 28; GNHC 2013m: 24; GNHC 2013n: 23; GNHC 2013o: 26, 30; GNHC 2013p: 27; GNHC 2013q: 13; GNHC 2013r: 20, 29-30, 47; GNHC 2013s: 19; GNHC 2013t: 18, 26, 29; GNHC 2013u: 20, 24; GNHC 2013v: 21, 31; GNHC 2013w: 21).

Disaster management

The risk of natural disasters is high in Bhutan and can be exacerbated by climate change. Thus, improving disaster preparedness and resilience of communities is essential and incorporated in the local eleventh five-year plans of all twenty dzongkhags. Increasing the number of disaster response teams at dzongkhag and gewog level and conducting trainings on disaster management and risk reduction are

key measures. Gasa, Haa, Samdrup Jongkhar, and Trashiyangtse also plan to finalise the provision of all schools with disaster management plans. In Bumthang, Dagana, Gasa, Paro, Punakha, Samtse, and Trashigang works for flood mitigation and riverbank protection are envisaged at the dzongkhag level, notwithstanding that individual gewogs also in other dzongkhags like Samdrup Jongkhar, Sarpang, Thimphu, and Trashiyangtse plan some works of river trenching, riverbank protection, or protection walls for local buildings. Samtse also highlights trainings on river and flood protection work for the urban development areas of two new yenlag thromdes (satellite towns), and Wangdue Phodrang notes stabilisation works on slopes prone to landslides along farm roads (GNHC 2013d: 20, 28, 37; GNHC 2013e: 19, 21, 35; GNHC 2013f: 15, 22; GNHC 2013g: 17-18, 32; GNHC 2013h: 14, 37; GNHC 2013i: 14; GNHC 2013j: 22; GNHC 2013k: 14, 37; GNHC 2013l: 21; GNHC 2013m: 17, 21; GNHC 2013n: 24, 53, 86; GNHC 2013o: 26, 43-45; GNHC 2013p: 21, 105; GNHC 2013q: 13, 73; GNHC 2013r: 21, 46; GNHC 2013s: 30, 37; GNHC 2013t: 19, 33; GNHC 2013u: 24; GNHC 2013v: 26, 39; GNHC 2013w: 22, 29).

Review observations

In this final part of the Eleventh Five Year Plan 2013-2018 analysis the twenty dzongkhag development plans confirm the high significance of agriculture, forests, and water as key and strongly intertwined areas for socio-economic development. However, as observed earlier in the analysis of the sectoral programmes of the eleventh plan, several planned sectoral measures lack explicit reference to climate change, yet their relevance for climate change mitigation and adaptation has been pointed out. Similarly, the local plans of the twenty dzongkhags incorporate key development measures in the areas of agriculture, forests, and water, yet mostly without reflecting their concurrent interlinkage to climate change mitigation and adaptation.

10. Observations and recommendations

National policies and strategies with relevance to climate change need to be translated into coordinated practical adaptation measures to be included into local development plans. Planning of sustainable adaptive measures requires local contextualisation and

social participation to explore new opportunities and to implement successful changes at local level. Processes of participatory planning, implementing and evaluating innovative approaches need to be based on awareness and applicable knowledge on climate change adaptation.

10.1. Observations

Institutional arrangements

High awareness of climate change is observed at the national institutional level with the Gross National Happiness Commission (GNHC) as the key planning institution, the few climate experts in the Climate Change Division of the National Environment Commission (NEC) as the focal agency for climate change, and also some expertise in technical departments and agencies for instance the National Biodiversity Centre (NBC) addressing climate impacts on biodiversity. However, there seems to be no sufficient dissemination of knowledge on climate change into all sectors and local governments, most probably due to lack of human resources and institutional capacities. Moreover, coordination between different agencies, departments and ministries and between the sectoral and local level could be improved. “While Bhutan has impressive plans, strategies and laws, implementation and monitoring capacity needs improvement” (GNHC 2011a: 81) GNHC stated on common institutional deficiencies, mentioned in the Bhutan National Human Development Report 2011 on the challenge of sustaining development progress in view of climate change.

At the same time, a well-organised participatory development planning process involving local communities is in place based on the decentralised political and administrative structures of the local governance system. Communication and information channels exist between central government agencies and their respective local officers at dzongkhag and gewog level, and capacity building programmes for local governments are conducted by the Department of Local Governance under the Ministry of Home and Cultural Affairs. Institutional arrangements like the mainstreaming reference group have been established to advice on coordination of more inclusive development planning processes across all sectors integrating cross cutting issues of gender, environment protection, climate change, disaster risk

reduction, and poverty alleviation (GECDP). GNHC has published a helpful framework to mainstream GECDP and trainings for local governments have been conducted for the eleventh five-year planning process.

However, still challenging seems to be effective coordination between different departments within one ministry or departments of different ministries and specialised non-departmental agencies with obviously partly overlapping mandates. For instance the National Biodiversity Centre (NBC) has brought up the issue of reviewing and realigning mandates of several institutions dealing with biodiversity and climate change and of establishing stakeholder meetings in order to achieve more effective coordination (NBC 2011: 33). Also within the Ministry of Agriculture and Forests (MoAF) biodiversity and hence planning of climate resilient biodiversity programmes is a cross-cutting issue among several departments such as the Department of Agriculture for agro-biodiversity, the Department of Livestock for biodiversity of animal husbandry, and the Department of Forests and Park Services for natural biodiversity areas, as well as the MoAF secretariat implementing the sectoral Biodiversity Conservation Programme. NBC on the other side is responsible for coordinating biodiversity conservation, providing documentation on biodiversity via the Bhutan Biodiversity Portal, and for the National Gene Bank conserving crop seeds and semen of local livestock breeds.

Another example for necessary coordination and alignment is the sector of disaster management in the sectoral programmes of the eleventh five-year plan. Disaster risk reduction and disaster preparedness, also important in the context of climate change, is targeted by different departments under three ministries, such as the Department of Disaster Management under the Ministry of Home and Cultural Affairs (MoHCA) as nodal agency, the Department of Geology and Mines and the Department of Hydromet Services under the Ministry of Economic Affairs (MoEA), as well as the Department of Engineering Services and the Department of Human Settlement of the Ministry of Works and Human Settlement (MoWHS).

The issue of improving coherence between the sectoral and the local level raises the question about the degree of alignment between local implementation of centrally planned sector programmes and local implementation of locally planned dzongkhag

programmes. In a kind of double role dzongkhag sector officers implement sector programmes being technically accountable to their respective ministries, and at the same time, support planning and implementation of local measures under the responsibility of local governments. Furthermore, dzongkhag sector officers support sector extension officers posted in the gewogs in implementing sector programmes, while at the same time, extension officers are the primary technical contact persons for planning and implementation of local programmes under the responsibility of the local administration.

Clarity of roles and responsibilities together with sufficient human resources and institutional capacities can contribute to improve local development planning and implementation for the benefit of local communities. General awareness on the climate change relevance of sectoral and local programmes as well as institutional interlinkages need to be increased for more consistent and climate resilient development planning.

Climate change relevance of development planning

Several GNHC recommendations from the Bhutan National Human Development Report 2011 on the challenge of sustaining development progress in view of climate change, specifically in the key areas of agriculture, forests, and water, are included in the eleventh five-year plan. Sectoral and local programmes for instance contain measures to develop more climate resilient agriculture, improve sustainable management of land and water resources, and promote forest rehabilitation (GNHC 2011a: 81). Likewise, adaption options listed by NEC in the updated National Adaptation Programme of Action (NAPA) II document 2012 are adopted in the eleventh five-year plan such as improving land use in degraded water catchment areas including afforestation, promoting watershed management and efficiency in irrigation, reducing soil erosion and water run-off on slopes, and enhancing community-based forest management (NEC 2012a: 26-27). Recommended technologies according to NEC's technology needs assessments for climate change mitigation and adaptation from March 2013 such as promoting biogas plants for rural communities and micro hydropower projects for remote areas replacing fossil fuel use, building of efficient irrigation systems such as sprinkler and drip irrigation, and supporting agro-forestry

and sloping agriculture land technology (SALT) are included in the eleventh five-year plan period from July 2013 to June 2018 (NEC 2013a: 36; NEC 2013b: 43, 48, 50, 52).

However, the climate change relevance of such measures often is not reflected in the sectoral and local programme descriptions indicating variable awareness of climate change at sectoral and local level. Inconsistent inclusion of climate change effects and responses results in a parallelism of policies and programmes with and without explicit consideration of climate change.

Regarding organic farming, as promoted by the National Organic Development Programme, one of the sectoral programmes of the Ministry of Agriculture and Forests, some activities are included in the current local dzongkhag plans. While organic farming still seems to play a minor part in the eleventh five-year plan, in the meantime awareness has increased, visible at the International Conference on Organic and Ecological Agriculture in Mountain Ecosystems in March 2014 in Thimphu, Bhutan. As outcome of the conference, the Thimphu Declaration considers organic farming as more climate resilient and relevant for enhancing food quality and security, highlights the important role of ecological smallholder agriculture for nutritious food production, and promotes the transition to organic farming in mountain areas (The Thimphu Declaration 2014: 2).

As the Thimphu Declaration sets the goal for transformation of agriculture towards organic farming, the challenge for the next five-year plan period from 2018 to 2023 remains how to further achieve significant increase in food production usually through high-yield crop varieties to enhance food self-sufficiency while promoting organic Bhutan. Another potential long-term conflict of interests could emerge between the required agricultural economic development to increase food production through introduced modern high-yield crops and breeds, and conservation efforts of a broad agricultural biodiversity as genetic diversity of native crops and livestock, also relevant for potential cultivation and breeding of locally adapted more climate resilient species.

The Gross National Happiness Commission has clearly stated that “human development is at acute risk of stalling or reversal due to climate shocks. This is a concern that must come to the centre of Bhutan’s policy design, development strategies and implementation” (GNHC 2011a: 83). Nonetheless, the occurrence of

knowledge dilution of climate expertise from the national level across different sectors down to the local planning level has been observed in the eleventh five-year plan analysis.

Overall, remarkable development of rural Bhutan is taking place through connection with electricity and information and communication technologies (ICT), motorable road construction, and expansion of services like education opportunities, basic health units, banking facilities, and community centres. Nevertheless, general challenges to further promote regionally balanced socio-economic development and revenue generation remain such as increase of agricultural, manufacturing and industrial productivity and employment generation including development of off-farm jobs, local industries, tourism, and markets; improvement of service delivery in the public and health sector; and enhancement of quality in education and research.

The intended graduation from the status of a least developed country to a lower middle income country also poses a challenge for future external resource mobilisation as traditional development partners are phasing out and additional financial sources like global funds need to be explored (GNHC 2016: 14).

For the next five-year plan period from 2018 to 2023 a shift in local development planning and dzongkhag responsibilities will have to be considered due to the declaration of new municipalities in all dzongkhags by the parliament in 2015. While development of quality urban facilities and services, transport services, employment generation and productivity, and security of energy, water and food supply is required, the new cities also can promote more balanced regional socio-economic development. In any case, climate resilience of urban and rural settlements should be incorporated at the outset of the planning process.

Aiming at more holistic development planning the challenge is how to overcome circumstances of isolated sectoral development planning, capacity building and knowledge management in order to align key national policies in the context of climate change mitigation and adaptation. Furthermore, harmonisation between sectoral and local planning will facilitate more consistent implementation of adaptive measures.

10.2. Recommendations

Available specialised knowledge on climate change mitigation and adaptation including localised vulnerability assessments and potential limits of adaptation needs to be systematically integrated into all sectoral programmes in alignment with local development planning at dzongkhag and gewog level. Participatory, well-informed and gender-sensitive decision-making processes at local level for change of practises will facilitate to identify appropriate options and consequences for communities.

Approach of institutional realignment

A comprehensive process of evaluating institutional mandates and capacities and assessing institutional arrangements and inter-agency cooperation procedures can lay the groundwork to accomplish up-to-date clarification, realignment, and strengthening of well-coordinated governance structures. Furthermore, purposeful capacity building and promotion of behavioural change at institutional level can considerably contribute to increase technical professionalism and targeted cross-sectoral cooperation, and to improve efficiency, effectiveness and quality of public service delivery to the people.

Promotion of a climate sensitive thematic thrust approach

Strengthening of cross-sectoral, inter-governmental and public-private cooperation on adverse climate change impacts through integrated climate sensitive development activities can be facilitated by involving all concerned stakeholders and grouping planned measures in a coordinated manner around identified key thematic thrusts. Such a thematic thrust approach visualises interdependences and synergies, avoids fragmentation and incoherence of activities, and focuses on key development objectives while enhancing climate resilience. Climate sensitive thematic thrusts could comprise low carbon emission technologies and energy efficiency for human settlements, industry, and transport linked to disaster resilient construction methods and diversification of alternative renewable energy sources; agro-biodiversity linked to food security and self-sufficiency, climate resilient agriculture, organic farming, agro-forestry, and sustainable land management, together with preservation of native genetic resources; and conservation and sustainable management of forests and non-wood forest products linked to promotion of manufacturing and timber industry

together with protection of water catchment areas and river flow management for water supply and hydropower.

Advancement of climate science

Strengthening of participatory and applied research on climate change responses, conservation of biodiversity, food security, and diversification of climate sensitive economic opportunities in cooperation with sectors, local governments and communities can facilitate enduring gain in applicable knowledge and practical results for equitable sustainable development. Improving research capacity and international networking of local scientists of the Royal University of Bhutan (RUB) and other national research institutions would help in providing the scientific basis for informed climate actions, including research on potential limits to adaptation. At the same time, cohesive and gender disaggregated data generation on climate change needs to be supported under guidance of the National Statistics Bureau (NSB) to create and collect comparable data for a nationwide database on climate change, preferably aligned and linked with regional data of the Himalayas.

A limit to adaptation can be defined “as a point at which an actor can no longer secure valued objectives from intolerable risk through adaptive action” (Dow et al. 2013: 306). Even if adaptation to climate change is understood as continuous process it might not turn out to be infinite, hence key development sectors such as agriculture, forests, and water resources need to be examined “to determine where limits may exist so that actors may anticipate and plan to mediate the hardships that cannot be avoided” (Dow et al. 2013: 306). Developing perspectives of long-term preparedness for climate change includes acknowledging the possibility that communities might reach a point where they face “limits in their capacity to adapt, and losses that are difficult to compensate for” (Dow et al. 2013: 307).

Using a “risk-based approach to defining limits to social adaptation provides a useful analytic framing for identifying and anticipating these limits and informing debates over society’s responses to climate change” (Dow et al. 2013: 305). Consequently, identification of potential limits to climate change adaptation, introduction of early warning systems for reaching these limits, and assessment of consequences beyond

feasible adaptation measures, for instance resettlement of highly vulnerable communities, need to be incorporated into climate sensitive development policies.

Enhancement of climate knowledge and information sharing

The eleventh five-year plan analysis indicates the necessity for appropriate knowledge sharing with local communities to increase their understanding of climate change impacts and possible responses and to enable well-informed social participation in local development planning and enhanced ownership in implementation of adaptive measures. Organising different events of knowledge sharing, for instance information campaigns, for communities on climate change impacts and local adaptation options will facilitate to strengthen community engagement.

Establishing publicly accessible information forums and communication channels with evidence-based climate science adequately translated into local socio-cultural contexts as well as information to policy makers for developing applicable and integrated cross-sectoral policies can increase the adaptive capacity of rural communities, urban centres, national economy, and social services.

By systematically collecting, consolidating and building on available knowledge and recommendations from different sectors and institutions the existing information and communication processes from central government agencies to their respective local officers will be broadened. Thus, creation of climate sensitive knowledge and dissemination of climate resilient practises at dzongkhag and gewog level should be integral part of long-term development planning. This includes the need to strengthen climate knowledge and capacities of local governments and sectoral extension services to ensure continuous support to communities in all gewogs across the country.

Promotion of transformed and climate resilient development cooperation

Advanced design of development cooperation with international donors can be created by further moving from project to national programme or sector budget funding according to the five-year plan's objectives, also ensuring balanced budgeting across sectors and regions. Additionally, international financial sources for climate change can be accessed in a nationally coordinated manner. Development targets and achievements need to be screened on climate resilience in order to increase long-term

sustainability while safeguarding investments from bilateral and multilateral development cooperation partners against adverse effects of climate change.

Administrative costs can be significantly reduced by avoiding parallel project cycle management structures including project planning, implementation, monitoring and evaluation, and reporting. Instead of employing separate project managers for frequently donor driven projects, often placed in departments of central agencies and without much coordination beyond their project and local pilot sites, enhancement of human capacities at dzongkhag and gewog level, together with technical assistance from central agencies, could meet the demand of implementing development activities under the responsibility of the local governments.

In this proposed model, new programmes with simultaneous screening on their climate resilience still can be developed after finalisation of a five-year plan, but only integrated into the activities of dzongkhag plans and booked either as sectoral budget support or as supplementary programme funds for the five-year plan budget. Also piloting of new activities can be undertaken in selected dzongkhags without parallel pilot project structures, embedded in the dzongkhag plans according to the five-year plan's objectives. As additional advantage, learning and results will be directly available at local level and promptly can be replicated or scaled up within the five-year plan period based on flexible formulation of annual local work plans of dzongkhags and gewogs. This also will enhance the relevance of the five-year plan reporting on national development without the need to refer to several separate programme and project reports.

Earmarked funds from development partners for programmes and sectoral budgets can make financial flows traceable and meet donor specific financial reporting requirements, yet included into one national fiscal and progress report. Standardised reporting format and comparable data generation will secure relevance and usability of the national progress report across all sectors for policy makers and statistics. Individual donor specific steering committee meetings can be integrated into one model of multi donor progress meetings at sectoral and dzongkhag level, back to back to joint monitoring and field visits, including aligned visits of international donor

representatives of resident and non-resident agencies, also enhancing international donor coordination, harmonisation, and alignment.

First steps in this direction already have been undertaken for instance in the governance sector with the setup of a multi donor sector steering committee meeting and reporting. Building on such experiences the new cooperation model, in consultation with donor agencies and national stakeholders, can be prepared, standardised and introduced across all sectors and local governments, spearheaded by the Gross National Happiness Commission as the responsible agency for coordinating financial development assistance in accordance with the five-year plans. This briefly outlined concept of transformed and climate resilient development cooperation can contribute in enhancing efficiency and effectiveness of sustainable development measures in the context of climate change.

Introduction of climate screening

At the organisational level, to support consistent integration of climate change into policies, programmes and plans, a compulsory screening process on climate change could be introduced, for instance conducted by the National Environment Commission (NEC) during the process of sectoral policy formulation and development of programmes and plans. Linked to the already mandatory screening process on gross national happiness by the Gross National Happiness Commission (GNHC), this additional dimension of climate screening could bridge knowledge gaps and ensure climate relevance of policies and programmes across all sectors.

To provide the necessary guiding framework for cross-sectoral mainstreaming into development planning formulation of a national climate change policy will be required. Consequently, in the five-year plans all planned measures with relevance for climate change need to be clearly labelled in the sectoral and local development plans. This methodological approach will improve clarity on planning and implementation of climate resilient programmes at dzongkhag level while enhancing the relevance of dzongkhag plans as key local planning instruments, highlight cross-sectoral and inter-dzongkhag cooperation and support consistent countrywide planning, evaluation and reporting on climate change. Thus, based on the five-year plans a comprehensive picture of climate resilient development planning in Bhutan can be provided.

Furthermore, NEC's climate screening could facilitate to achieve cross-sectoral integration of climate relevant measures, aligned with the national climate change policy, into the upcoming formulation of Bhutan's first National Adaptation Plan (NAP). For its purpose of integrating climate change adaptation into national development planning the NAP needs to be harmonised with the country's long-term development objectives. The question is whether the NAP formulation process could provide consolidated mitigation and adaptation priorities with all cross-sectoral linkages in one key climate change reference document to be integrated into the main development planning instrument of the five-year plan for the next period from 2018 to 2023. In this way the new NAP document could ensure incorporation of climate change into development planning at national, sectoral and local level in a coherent, sustainable and gender-sensitive manner. For this purpose, NEC would need adequate strengthening of human resources of its qualified but small Climate Change Division.

Integration of climate resilience into the concept of gross national happiness

At the conceptual level, given the high importance of proactive responses to climate change for socio-economic development, environment conservation, and preservation of cultural heritage, interlinked with the government's responsibility to ensure a sustainable future for the people, it is obvious that climate change becomes intrinsically tied to the development philosophy of gross national happiness. Climate resilience of ecosystems, rural communities, urban centres, infrastructure, economy and social services together with long-term adaptation and development planning will form the basis for a climate adaptive society.

Thus, to avoid parallel conceptualisation of societal climate resilience and societal holistic development, it could be considered to adapt the concept of gross national happiness (GNH), for instance by including a fifth pillar of climate resilience, complementing the four pillars of good governance, sustainable socio-economic development, cultural preservation, and environmental conservation. The recognition of values and different areas of well-being within GNH might as well include well-being in preparedness for inevitable climate change, hence supporting and safeguarding other dimensions of sustainable development.

In any case, additional GNH domains such as climate change preparedness and adaptive capacity or climate resilience of people, societal and ecological systems could complement the existing nine GNH domains of psychological well-being, health, time use, education, cultural diversity, community vitality, good governance, ecological diversity, and living standards. In collaboration with the Centre for Bhutan Studies and GNH Research (CBS) appropriate indicators reflecting skills in climate adaptive practises and status of climate resilience in various areas could be developed to be integrated into future GNH surveys and GNH index measurement of achieved sufficiency within the different domains.

Consequently, the Gross National Happiness Commission (GNHC) would be the nodal agency for climate resilient GNH screening and development instead of different spheres of institutional responsibility. For this purpose, GNHC either would need to be adequately equipped with a team of climate experts and preferably some social and cultural anthropological expertise as well, or could conclude an outsourcing agreement on division of labour with the National Environment Commission (NEC).

Advantage of this proposal of GNH concept adaptation would be the highly visible inclusion of climate change into the core comprehensive and recognised development concept of GNH, henceforth ensuring due significance of climate resilience in the country's overall development approach.

As adaptation to change is essential for survival in view of multiple drivers of economic, social, cultural, environmental and climate change holistic strategic and climate sensitive development planning based on the nexus and mutual exchange between applied sciences, coherent policies, informed social participation, and sustainable practices can foster the pursuit of gross national happiness for a climate resilient future for the people of the Kingdom of Bhutan.

11. Applied research

This study aims to facilitate the use of its research results for practical implementation. The review observations and findings of this study on analysing local development planning in the context of climate change in Bhutan can be considered in processes of national and sectoral policy amendment and development. Furthermore, the findings can be linked to the policy context of the national adaptation plan (NAP) development process in Bhutan, coordinated by the National Environment Commission (NEC). The research results can be considered for future local development planning in Bhutan, starting with the preparation phase of the Twelfth Five Year Plan 2018-2023, coordinated by the Gross National Happiness Commission (GNHC), specifically for sectoral programmes and local dzongkhag plans. If suitable, the final part of observations and recommendations can be considered by relevant agencies as conceptual, methodological and practical inputs for supporting sustainable and climate resilient development planning in Bhutan.

12. Abbreviations and glossary

12.1. Abbreviations

ACC	Anthropogenic climate change
ADB	Asian Development Bank
AGW	Anthropogenic global warming
AOSIS	Alliance of Small Island States
BBP	Bhutan Biogas Project
BDB	Bhutan Development Bank
BNB	Bhutan National Bank
BOB	Bank of Bhutan
BTFEC	Bhutan Trust Fund for Environmental Conservation
BTN	Bhutanese Ngultrum (Currency of Bhutan)
CBD	Convention on Biological Diversity
CBS	Centre for Bhutan Studies and GNH Research
CCA	Climate change adaptation
CDM	Clean Development Mechanism

CF	Community forest
CHS	Commission on Human Security
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO ₂	Carbon dioxide
COP	Conference of the Parties (UNFCCC)
CoRRB	Council for Renewable Natural Resources Research of Bhutan (Ministry of Agriculture and Forests, Royal Government of Bhutan)
DDM	Department of Disaster Management (Ministry of Home and Cultural Affairs, Royal Government of Bhutan)
DGM	Department of Geology and Mines (Ministry of Economic Affairs, Royal Government of Bhutan)
DGPC	Druk Green Power Corporation
DHI	Druk Holding and Investments
DKRA	Dzongkhag key result area
DLG	Department of Local Governance (Ministry of Home and Cultural Affairs, Royal Government of Bhutan)
DPB	Druk Punjab Bank
DPO	Dzongkhag planning officer
DRE	Department of Renewable Energy (Ministry of Economic Affairs, Royal Government of Bhutan)
ECBC	Energy Conservation Building Code (India)
ECCD	Early childhood care and development
ELA	Equilibrium-line altitude
EWS	Early warning system
FAO	Food and Agriculture Organisation of the United Nations
FFFSR	Friends of Fossil Fuel Subsidy Reform
G8	Group of Eight (Canada, France, Germany, Italy, Japan, Russia, the United Kingdom, and the United States)
G8+5	Group of Eight plus Brazil, China, India, Mexico, and South Africa
GAO	Gewog administrative officer
GDP	Gross domestic product
GECDP	Gender, environment, climate, disaster, and poverty
GHG	Greenhouse gas
GIS	Geographic information system

GLOF	Glacial lake outburst flood
GNH	Gross national happiness
GNHC	Gross National Happiness Commission (Royal Government of Bhutan)
GRF	Government reserved forest
GWh	Gigawatt-hour
HRC	Human Rights Council
HRW	Human Rights Watch
IASC	Inter-Agency Standing Committee
ICIMOD	International Centre for Integrated Mountain Development
IFAD	International Fund for Agricultural Development
ILO	International Labour Organisation
IMTRAT	Indian Military Training Team (based in Bhutan)
INC	Initial National Communication
INDC	Intended Nationally Determined Contribution
IOM	International Organisation for Migration
IPCC	Intergovernmental Panel on Climate Change
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
KWh	Kilowatt-hour
LDC	Least developed country
M	Magnitude
MDGs	Millennium Development Goals
MoAF	Ministry of Agriculture and Forests (Royal Government of Bhutan)
MoEA	Ministry of Economic Affairs (Royal Government of Bhutan)
MoHCA	Ministry of Home and Cultural Affairs (Royal Government of Bhutan)
MoWHS	Ministry of Works and Human Settlement (Royal Government of Bhutan)
MU	Million units
MW	Megawatt
NAB	National Assembly of Bhutan
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NAS	US National Academy of Sciences

NBC	National Biodiversity Centre (Ministry of Agriculture and Forests, Royal Government of Bhutan)
NDTV	New Delhi Television
NEC	National Environment Commission (Royal Government of Bhutan)
NGO	Nongovernmental organisation
NKRA	National key result area
NLC	National Land Commission
NPPF	National Pension and Provident Fund
NSB	National Statistics Bureau (Royal Government of Bhutan)
NSIDC	National Snow and Ice Data Centre
NWFPS	Non-wood forest products
PC	Planning Commission (erstwhile, Royal Government of Bhutan)
RBA	Royal Bhutan Army
RCSC	Royal Civil Service Commission (Royal Government of Bhutan)
REDD+	Reducing emissions from deforestation and forest degradation in developing countries (UNFCCC)
REN21	Renewable Energy Policy Network for the 21st Century
RGoB	Royal Government of Bhutan
RICB	Royal Insurance Corporation of Bhutan
RMA	Royal Monetary Authority (Royal Government of Bhutan)
RNR	Renewable natural resources
RSEB	Royal Securities Exchange of Bhutan
RUB	Royal University of Bhutan
SALT	Sloping agriculture land technology
SDGs	Sustainable Development Goals
SLM	Sustainable land management
SNC	Second National Communication
TCB	Tourism Council of Bhutan
UK	United Kingdom
UKCCMC	UK Climate Change and Migration Coalition
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

UNFCCC	United Nations Framework Convention on Climate Change
UNHCR	United Nations High Commissioner for Refugees
USA	United States of America
USGS	US Geological Survey
V20	Vulnerable Twenty Group of Ministers of Finance
WBGU	German Advisory Council on Global Change
WEF	World Economic Forum
WFP	World Food Programme
WMO	World Meteorological Organisation

12.2. Glossary

Chhu	River
Chiwog	Cluster of villages; territorial unit under a gewog
Driglam Namzha	Bhutanese traditional code of etiquette
Druk Gyalpo	Dragon King (King of Bhutan)
Druk Yul	Land of the Dragon (Kingdom of Bhutan)
Dzong	Fortress; dzongkhag administration centre
Dzongdag	Governor; dzongkhag administrator
Dzongkha	National language
Dzongkhag	District
Dzongkhag tshogdu	District assembly
Dzongrab	Deputy governor; deputy dzongkhag administrator
Gewog	County; local administration unit under a dzongkhag
Gewog tshogde	County council
Gung	Household
Gup	Elected head of a gewog
Lama	Buddhist teacher
Layaps	People of Laya gewog in Gasa dzongkhag
Mangmi	Elected deputy head of a gewog
Menjong yul	Land of medicinal herbs
Menpa	Traditional healer
Sokshing	Forest land for leaf litter collection

Thram	Land title document
Thromde	City
Thromde tshogde	City council
Thrompon	Mayor; city administrator
Tsa-Wa-Sum	King, country and people
Tsamdro	Grazing land
Tshogpa	Elected representative of a chiwog
Yartsa goenbub	Cordyceps (<i>Ophiocordyceps sinensis</i>); parasitic caterpillar fungus
Yenlag thromde	Satellite town
Zomdu	Community meeting

13. Abstract

Anthropogenic global climate change caused by emission of greenhouse gases is observed additionally to a natural variability of climate. It is scientific consensus that mean temperature increase needs to be stabilised to below two degrees Celsius relative to pre-industrial levels to reduce severe impacts on people and ecosystems. Beyond a natural scientific perspective this anthropological study explores social, economic and political dimensions of climate change intrinsically linked to social aspects of vulnerability, gender equality and social justice. Climate change can exacerbate existing socio-economic inequalities, thus needs to be incorporated into policies and plans of sustainable development, specifically in least developed countries. The study further outlines the socio-political relevance of climate change in conjunction with food insecurity, conflicts, and migration, and reviews current perceptions of climate change mitigation and adaptation, as well as international politics, scientific consensus, and climate change denial.

A presentation of the Himalayan region and its climate change commonalities is followed by the thematic introduction of the Kingdom of Bhutan as the study's geographic field of research on development planning in the context of climate change. Institutional setup, national laws, policies and programmes related to climate change are examined including local history of development planning and governance structures. Providing an overview of Bhutan's decentralised development planning

process and social participation of local governments and communities the study further conducts a detailed analysis of the current development plan of the country, the Eleventh Five Year Plan 2013-2018, on inclusion of climate change relevant measures at the national, sectoral and local level.

The study concludes that national policies and strategies with relevance to climate change need to be more consistently translated into coordinated adaptation measures at local level to address climate change specifically in the key development sectors of agriculture, forests, and water resources, and that participatory planning and implementation of climate resilient development measures need to be based on increased community awareness and knowledge on climate change adaptation. Considering the nexus of applied sciences, coherent policies, informed social participation, and sustainable practices the study in final recommendations advocates conceptual integration of climate resilience into Bhutan's holistic development concept of gross national happiness.

Abstract (German)

Anthropogener globaler Klimawandel verursacht durch Emission von Treibhausgasen wird zusätzlich zu natürlichen Klimaschwankungen beobachtet. Es besteht wissenschaftlicher Konsens, dass die durchschnittliche Temperaturerwärmung auf unter zwei Grad Celsius in Relation zu vorindustriellem Niveau stabilisiert werden muss um schwerwiegende Auswirkungen auf Menschen und Ökosysteme zu verringern. Über eine naturwissenschaftliche Perspektive hinaus erforscht diese anthropologische Studie soziale, wirtschaftliche und politische Dimensionen des Klimawandels, untrennbar verbunden mit sozialen Aspekten von Verwundbarkeit, Gleichberechtigung der Geschlechter und sozialer Gerechtigkeit. Klimawandel kann bestehende sozio-ökonomische Ungleichheiten verschärfen und bedarf deswegen der Einbeziehung in Politiken und Pläne zur nachhaltigen Entwicklung, vor allem in am wenigsten entwickelten Ländern. Die Studie behandelt weiters die sozio-politische Bedeutung von Klimawandel in Verbindung mit unsicherer Ernährung, Konflikten und Migration, und überprüft gegenwärtige Auffassungen von Verminderung von und Anpassung an Klimawandel, sowie internationale Politik, wissenschaftlichen Konsens und Leugnung des Klimawandels.

Einer Darstellung der Himalaya Region und ihrer Gemeinsamkeiten in Bezug auf Klimawandel folgt die thematische Einführung in das Königreich Bhutan als geografisches Forschungsfeld dieser Studie über Entwicklungsplanung im Kontext des Klimawandels. Institutionelle Aufstellung, nationale Gesetze, Politiken und Programme mit Bezug auf Klimawandel werden untersucht, einschließlich der lokalen Geschichte der Entwicklungsplanung und Regierungsstrukturen. Nach einem Überblick über Bhutans dezentralisierten Prozess der Entwicklungsplanung und gesellschaftlicher Mitwirkung lokaler Regierungen und Gemeinden erstellt die Studie eine detaillierte Analyse des gegenwärtigen Entwicklungsplans des Landes, des Elften Fünfjahresplans 2013-2018, auf Inkludierung von Klimawandel relevanten Maßnahmen auf nationaler, sektoraler und lokaler Ebene.

Die Studie kommt zu dem Schluss, dass nationale Politiken und Strategien mit Relevanz für den Klimawandel einer einheitlicheren Übersetzung in koordinierte Maßnahmen der Anpassung auf lokaler Ebene bedürfen um Klimawandel speziell in den zentralen Entwicklungssektoren von Landwirtschaft, Wald und Wasserressourcen zu adressieren, und dass partizipative Planung und Umsetzung von klimabelastbaren Entwicklungsmaßnahmen eine Basis von verstärktem Bewusstsein und Kenntnissen von Gemeinden über Anpassung an Klimawandel erfordern. Den Konnex von angewandten Wissenschaften, kohärenten Politiken, informierter gesellschaftlicher Teilnahme und nachhaltigen Praktiken berücksichtigend befürwortet die Studie in abschließenden Empfehlungen die konzeptuelle Eingliederung von Klimabelastbarkeit in Bhutans ganzheitliches Entwicklungskonzept des Bruttonationalglücks.

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14.1. Introductory note

Due to the years of work and residence in Bhutan and Nepal, the later study visit to Bhutan, and subsequent extensive travelling through Southeast Asia during the period of analysis and thesis formulation the vast majority of research related documents and references used in this dissertation was collected as online sources. For these reasons, printed literature as well is listed with correspondent online links wherever available. Beyond practical aspects of mobile research work online sources also facilitate traceability and usability for the interested audience.

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