CHAPTER 4

Vulnerability and adaptation of forests and communities in Central Africa

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1. Introduction

There is growing evidence that the global climate is changing. The impacts and response to climate change will vary from one region to the other and from one country to the other due to differences in natural resource dynamics and institutional and governance capacity. It is important for central African countries to recognize the risk posed by climate change on life supporting systems in the region. This is relevant for policy design and implementation in relation to financial, governance and technical needs.

2. Vulnerability to climate change in Central Africa

2.1. Vulnerability of forest ecosystems and peoples to climate change: why adaptation matter for the region?

Many vulnerability studies focus on the arid and semi-arid regions of the African continent, paying less attention to the Central African region. However, emerging evidences show that both its forests and people are also vulnerable to climate change (CSC, 2013). The region is going to experience increase in climate variability and changes in the hydrological systems. Similarly, the differences between seasons and between years are expected to become larger. The region is going to suffer from more intense rainfall and flash floods in the wet seasons, while the dry season could become either wetter or drier. Near surface temperatures are expected to increase in the future (de Wasseige *et al.*, 2014) (see chapter 2). Like other forests, the forest ecosystems in the region are sensitive and exposed to the changing climate which will further be exacerbated by other drivers such as land use change, land fragmentation, and over exploitation of forest resources (Sonwa *et al.*, 2012b). Furthermore, the forest ecosystems might also suffer from disturbance regimes such as pests, fires and diseases.

Photo 4.1: Road construction may locally impact the surrounding forest through changes in soil condition

Photo 4.2: Wildlife is particularly vulnerable near villages

Communities are already experiencing distortion in their livelihood systems due to changing seasons, variation in temperature and precipitation (Bele *et al.*, 2013). The livelihoods of the millions of people in the region depend on vulnerable activities and resources such as agriculture, forests for household energy, food and fiber, water supply, herbs and tree barks for health care (Sonwa *et al.*, 2012b). Crop and climate models indicate that climate variability and change are influencing the sowing dates and growing-season temperature, which have long-term effects on crop yields in some areas in the region (Tingem *et al.*, 2009). It is highlighted that a 1 mm/day increase in rainfall predicted for much of the Congo Basin by the 2050s may cause a basin wide increase in the frequency of heavy rains during the dry season. Thus causing a reduction in the size of slash and burn farmers' fields, and potentially a substantial increase in the food insecurity of poor rural families across the region (Wilkie *et al.*, 1999). Furthermore, vulnerability will be exacerbated due to changes in environmental policies related to access to forest resources (Peach-Brown *et al.*, 2010).

Central African forests play a key role from the global to the local level, but they are subject to climate variability and impacts. Paleontological studies have shown how forest have migrated, fragmented or disappeared across in the sub-region due to changes in the climate regimes (see chap 2 or 3). Not only they constitute an important source for the current economy and wellbeing of populations, but also they host important genetic biodiversity that might provide responses for future threats (de Wasseige *et al.,* 2014). Furthermore, the central African population is expected to double by 2050, with the subsequent pressure on natural resources. UN projections for the continent estimate an increase from 1.1 billion to 2.4 billion by mid-century (UN, 2012). In addition, rapid urbanization will affect consumption (UN, 2015). Adaptation policies need to be mainstreamed in the region to secure stable development of its populations and global climate.

2.2. Vulnerability of economic and social sectors

As described in chapter 3, vulnerability is the combination of exposure, sensitivity and adaptive capacity. The socio-economic sectors and livelihoods of central African countries and its populations present different abilities to react to climate stimuli. Furthermore, they are highly dependent on the surrounding ecosystems that constitute a significant proportion of the gross domestic product of the countries in the region. This implies climate change might jeopardize the successful implementation of any sustainable economic and national development plans. Furthermore, climate change will constrain countries in the region to realize global targets such as the millennium development goals. At the local level, forests provide important goods for food security, local economy, housing and health (de Wasseige *et al.*, 2014).

Land use and the climate can have both immediate and sustained effects on hydrology (Li *et al.*, 2007). Furthermore, changes in hydrology can have both positive and negative impacts on economic sectors, infrastructures and agriculture, among others. It is nevertheless important to highlight that climate change impact will vary across the sub-region and across sectors.

In this context, forests could play a key role for short-term and mid-term adaptation, at smaller scales due to its potential for water provision, flood regulations and provision of medicinal plants (Sonwa *et al.*, 2012a). Ecosystem-based adaptation has been an important approach defined as having high potential for the Congo Basin region (IPCC, 2014 ; Somorin *et al.*, 2012 ; Sonwa *et al.*, 2012a).

2.2.1. Hydrology and energy

The repercussions of past climate variations on watercourses are reflected in changes in their regimes. Several studies have shown drops of a 43 % to 74 % in the Sahelian rivers from 1970 to 1990, with consequences on natural lakes. For example, the surface of Lake Chad got reduced by 4 to 12 times during the period 1955-1975 (Lemoalle *et al.*, 2012). In humid tropical Africa, the decrease reached 32 % of the flow of the rivers to the Atlantic ocean (de Wasseige *et al.*, 2014). The decline in flows has repercussions on the quantity of water filling lakes, which are natural reservoirs. On the other hand, an increase in precipitation was recorded beginning in the 1990s in certain regions of the Congo Basin, leading to an increase in the flow of certain watercourses (Conway *et al.*, 2009).

Climate projections indicate increases in flow variability, intensification of high flows and decreases in low flows. Consequently, the region could benefit from hydropower plant production. However, the increases in extreme events will require infrastructures that are more resistant. Furthermore, changes in variability will need to be overcome by combination with other power sources, electricity accumulators and reliable distribution networks (CSC, 2013).

2.2.2. Agriculture

Water and temperature regimes condition agricultural production. This is particularly true in Africa where subsistence agriculture predominates and smallholders produce about 80% of the food consumed (AGRA, 2014). As such, crop production is mostly rain-fed, and technologies to control temperature (such as greenhouses) are not yet widely applied. Projected variability across zones indicates the northern zones of the basin will be less prone to drought with increases in agricultural production. However, in the central region, increases in water might be such that they can lead to floods damaging crops. In the southern zones agricultural production will start decreasing halfway the century, due to changing evapotranspiration balances, being prone to droughts as well (CSC, 2013). In addition, changes in humidity will influence nutrient availability, and impacts of pest and diseases (de Wasseige *et al.*, 2014).

2.2.3. Health

It is recognized that climate change is a direct (insufficient access to safe water and improved sanitation, food insecurity) and indirect (limited access to health care and education) multiplier of existing health vulnerabilities (IPCC, 2014). Changing temperature and precipitation patterns will impact health due to malnutrition, diarrheal diseases, and malaria and other vector-borne diseases. Malnutrition problems could be tackled in the northern part of the Congo Basin due to increased agricultural production, but diarrheal diseases, malaria and water-borne diseases could further affect throughout the region due to increased temperatures and floods. Health is especially vulnerable in context of poor health-care systems combined with poor governance and lack of infrastructure.

2.2.4. Urbanization

Many of the interacting social, demographic, and economic drivers of observed urbanization and migration in Africa are sensitive to climate change impacts. Climate change is triggering rural-urban migration. In addition, rapid urbanization is mostly unplanned, with infrastructure and distribution plans not adapted to projected floods and extreme events. Furthermore, urbanization is leading to transformation of the food systems with increase in purchased food in urban areas. Production, processing, transport, storage and preparation will need to be adapted to future threats (IPCC, 2014).

Photo 4.3: Terraced crops dominate the landscape of Rwanda

Photo 4.4: Agriculture and timber industry are now the main economic activities of the former mining town Makabana (Congo)

Box 4.1: *CCAFS projections on crop yields*

Vulnerability varies not only across zones, but also different crops are affected differently. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) has produced scenarios for crop suitability across Africa. In Central Africa the areas suitable for pearl millet, Sorghum, and tubers such as cassava and yam are stables or show either little area loss or even gains whereas crops such as banana, maize and beans will be affected negatively.

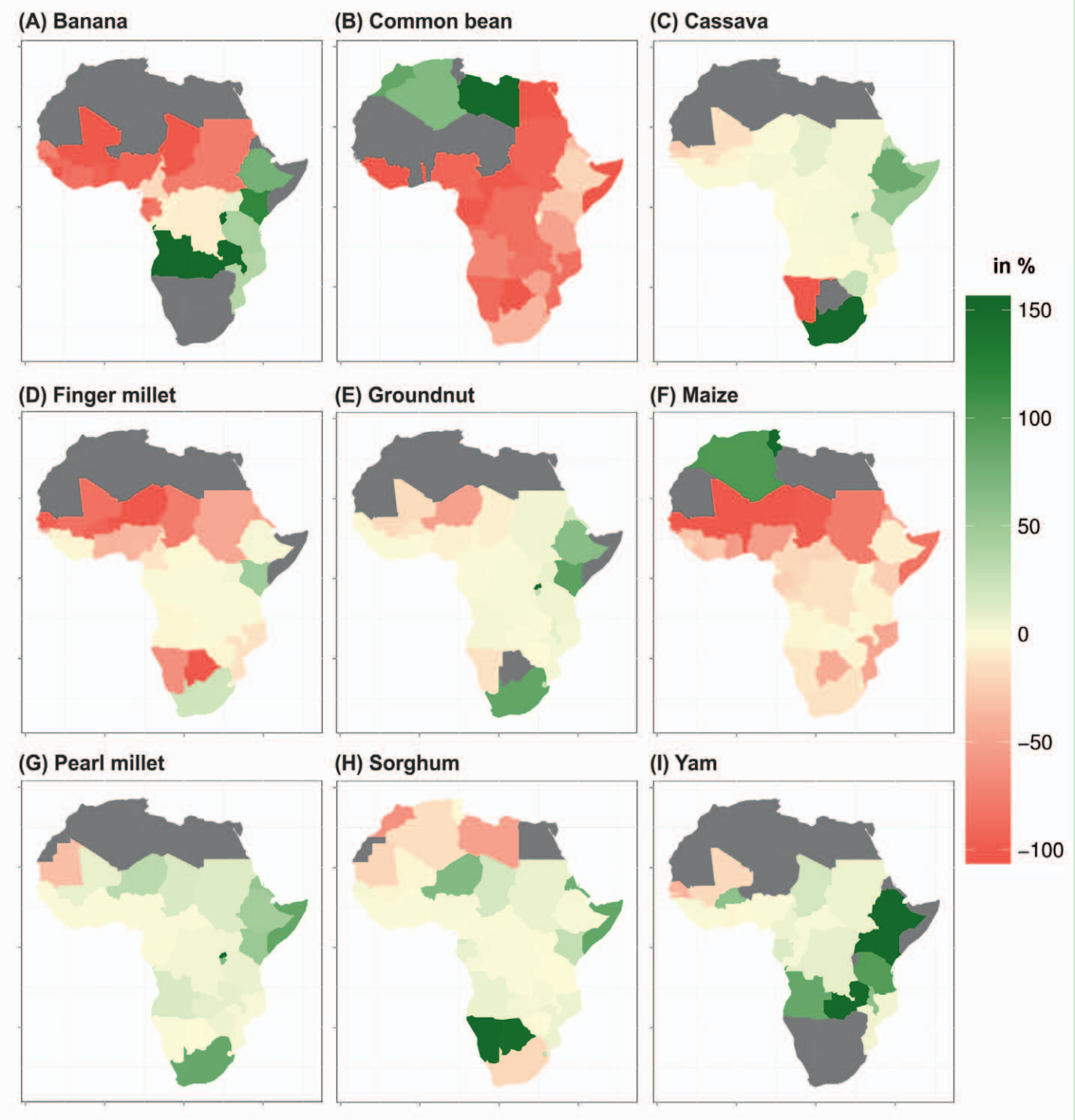

Figure 4.1: Maps showing scenarios for crop suitability in the context of climate change across Africa.
Source: Ramirez-Villegas and Thornton (2015).

3. Adaptation of forest and forest peoples to climate change

Adaptation measures for forest ecosystems ("adaptation of forest") are required to guarantee the health of forest ecosystems and the continuous provision of ecosystem goods and services, which are indispensable for economic growth and the adaptation of forest peoples ("forest for adaptation") (Figure 4.2). Adaptation strategies are twofold. First, adaptation requires political and technical measures (Figure 4.2). Second, adaptations requires the enhancement of the adaptive capacity of forest communities on one hand through ecosystem services, and on the other hand through improved tenure, improved infrastructure and technology, capacity building of diverse local institutions and improve relationships between local and national-level adaptation planning efforts. Local and national adaptation plans need to target poverty reduction, food security, water availability and biodiversity conservation (Peach-Brown and Sonwa, 2015; Sonwa *et al.*, 2012b). Adaptation strategies need to be continuously mainstreamed into decision making whereby strategies are assessed in terms of the degree to which they are effective; their technical feasibility, cost and benefits are evaluated; feasible and economically justified options are implemented; the performance of adaptation is monitored and evaluated; and adaptation strategies are modified if necessary (Bele *et al.*, 2015).

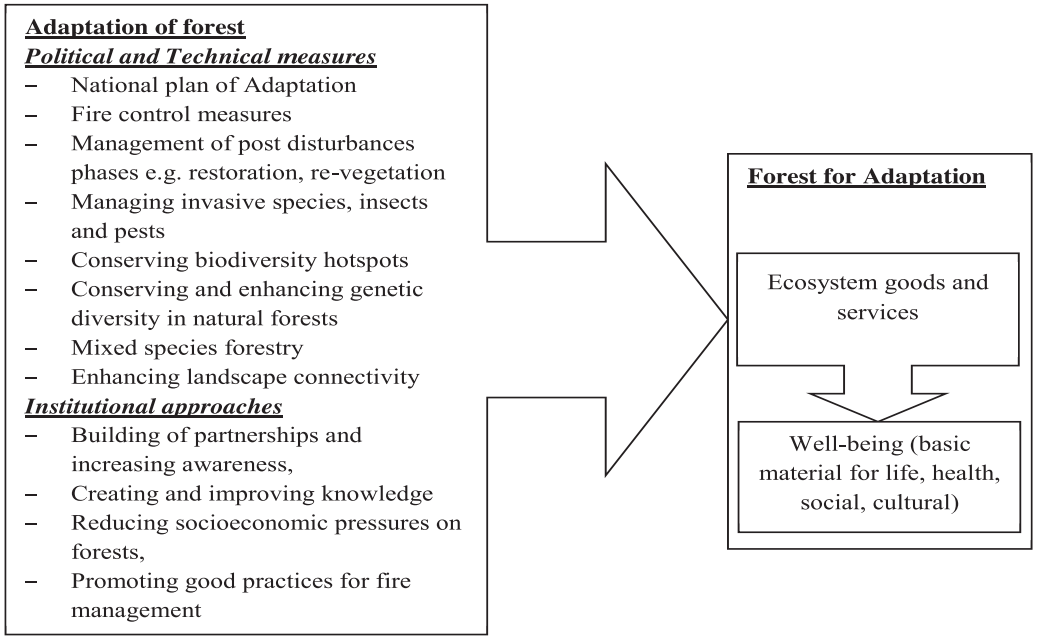

Figure 4.2: Adaptation strategies for forests and forest for adaptation.

Source: Guariguata et al., 2008; Locatelli et al., 2008; Ravindranath, 2007.

3.1. Policy and institutional responses to climate change vulnerability

3.1.1. Adaptation policy and institutional dynamics in Central Africa

The adaptation of forests and peoples in Central Africa depends on existing and future regional and national policy and institutional efforts and orientations. The climate change adaptation policy process entails the different courses of action responsible for crafting strategies that enhance adaptation. Through this process, new approaches are expected to be designed and/or integrated/mainstreamed into existing forest and development policies. Institutions provide cross-cutting forces and arrangements (Young, 2002), which are relevant for negotiating and facilitating the design and implementation of adaptation strategies at the local level (Agrawal, 2010); and at the national and regional levels (Koch *et al.*, 2007). All the countries of the Central Africa (CA) region are parties to the UNFCCC, which underscores their interest to provide policy response to combat climate change.

Photo 4.5: Performed sparingly, collecting firewood can be sustainable (Burundi)

Their efforts are demonstrated through the UNFCCCs National Communications (NCs) and the National Adaptation Program of Action (NAPA) initiatives. NCs highlight vulnerable sectors and potential measures to facilitate adaptation to climate change. The NAPA initiative tailored for Least Developed Countries (LDCs) is relevant for some countries of the CA region (Table 4.2), where they have made attempts to identify priority areas and activities that respond to their urgent needs related to climate change adaptation. Despite these efforts, the policy and institutional processes are still characterized by limited coordination, weak institutional linkages and lack of coherence between sectoral policies (Kengoum, 2013; Dkamela, 2011). There is a need to build capacities, strengthen institutional networks both at the level of policy-making as well as at the level of implementation of adaptation strategies (Peach-Brown *et al.*, 2013).

The forest ecosystems of the Congo Basin provide ecosystem goods and services which are safety nets and relevant for the adaptation of forest-dependent peoples (Nkem *et al.*, 2010). Notwithstanding, the existing policy frameworks are still to, seriously consider the role of forest resources in climate change adaptation planning (Bele *et al.*, 2011). In the past, climate change adaptation has received less attention in the policy and institutional response process due to limited information and knowledge on adaptation (Somorin *et al.*, 2012). Clear-cut information on the cost, benefits, options and the impacts of possible adaptation choices which are relevant for decision makers is lacking for the region. At the regional level, the COMIFAC, with support from national and international governmental organizations, national and international non-governmental and research institutions, is making attempts to propel the adaptation agenda and climate change response in general. In its recent 10 years (2015-2025) convergence plan, the fight against climate change is included as one of the priority areas. However, technical, financial and institutional support will be required for the Commission and member countries to operationalize the different strategies accompanying the priority areas of the convergence plan. In the context of the Central Africa region, the challenges for adaptation in the climate change policy process might be easier to overcome due to the strong links between climate vulnerability and poverty and development strategies. Development and poverty reduction are priority areas for countries in the COMIFAC space. Thus, this should be used as an opportunity for adaptation, by integrating adaptation strategies into current development plans and poverty reduction strategies (Sonwa *et al.*, 2012b).

In the advent of climate change responses, institutions involved in policy development and implementation need to revise, change and take on new roles to be in a position to facilitate and enforce new policies, become flexible and able to learn and adapt to the changing human-environmental system which is characterized by uncertainty (Locatelli *et al.*, 2008). First, state agencies should be responsible for mainstreaming adaptation into national policies, sourcing financial resources and influencing and coordinating the course of action at the international, national and local levels. Second, non-state agencies which include national and international NGOs and research organizations should provide support related to awareness raising, mobilization of efforts, promotion of inter-ministerial dialogue, collaboration, networking, knowledge generation and capacity building (Chia *et al.*, 2014).

3.1.2. Financial and funding opportunities in the region

Climate change adaptation is a financial burden for countries in the Central Africa region (Somorin *et al.*, 2012). It is important to note that, globally it is unclear whether sufficient funds will be available to address the adaptation needs of developing countries which threatens to surpass $50 billion per year after 2020 (Smith *et al.*, 2011). Countries of the CA region have accessed and benefited differently from the adaptation fund under the UNFCCC framework (Table 4.1). Many opportunities are still available, highly dependent on the countries' capacities to propose adaptation projects. Apart from the funding sources under the UNFCCC framework, other policy and funding options relevant for CA countries include multilateral and bilateral assistance through development banks and overseas Development Assistance. According to Smith et al (2011), a substantial share of present development assistance is spent on climate sensitive projects. In this context, it is argued that climate change adaptation should be factored in all development assistance that are climate sensitive (Huq and Burton, 2003). Thus, coordinating the two funding streams at the national and international levels may provide more effective support for both sustainable development goals and climate change adaptation. This approach is crucial for COMIFAC countries.

Table 4.1: *National level funding opportunities for adaptation in Central Africa.*

Operational since	Currently operational	Fund name	Administrative body	Eligible COMIFAC countries	COMIFAC countries benefited to date ($ million)
1993	Yes	Global Environmental Facility Trust fund (GEF) – Climate Change and Land Degradation focal areas	GEF	All	Burundi (7.24), Cameroon (9.23), CAR (0.35), Chad (2.62), Congo Brazzaville (2.36), DRC (3.63) Equatorial Guinea (3.50), Gabon (0.77), Rwanda (4.83), Sao Tomé & Principe (0.35)
2002	Yes	Least Developed Countries Fund (LDCF)	GEF-WB	Burundi, Central African Republic (CAR), Chad, Democratic Republic of Congo (DRC), Equatorial Guinea, Rwanda, Sao Tome and Principe	Burundi (13.19), CAR (11.17), Chad (13.00), DRC (20.67), Rwanda (24.51), Sao Tome and Principe (16.17)
2002	Yes	Special Climate Change Fund (SCCF)	GEF-WB	All	Cameroon (4.55)
2004	No	Strategic Priority for Adaptation (SPA)	GEF	All	None
2007	Yes	Millennium Development Goals Achievement Fund – Environment and Climate Change thematic window (MDG-F)	UNDP	DRC, Equatorial Guinea, Sao Tome and Principe	None
2008	Yes	Fast-Start Financing (FSF)	Japan's Ministry of Finance	All	Burundi (2.6), DRC (31.6)
2008	Yes	International Climate Initiative (IKI)	BMU	All	COMIFAC countries (1.67), Rwanda (1.76)
2008	Yes	Global Climate Change Alliance (GCCA)	EuropeAid	Burundi, CAR, Chad, DRC, Equatorial Guinea, Rwanda, Sao Tome and Principe	CAR (6.19), Chad (4.05), DRC (5.48), Rwanda (10.27), Sao Tome and Principe (3.27)
2008	Yes	Pilot Program for Climate Resilience (PPCR)	WB	All	None
2009	Yes	Adaptation Fund (AF)	WB	All	Rwanda (3.20)
2011	Yes	International Climate Fund (ICF)	DFID	All	CBFF (35.00), contributions to other funds mentioned in the table
2012	Yes	Adaptation for Smallholder Agriculture Program (ASAP)	IFAD	All	Rwanda (7.00)
TBC	TBC	Green Climate Fund (GCF)	GCF	All	None

Sources: Adaptation Fund (2015); AECID (2005); GEF (2014); HBF & ODI (2015); MDG Achievement Fund (2013); PPCR (2015); UNFCCC (2015d).

3.1.3. Policy and institutional enabling conditions

The revising of existing policies and the creation of new policies should provide opportunities to achieve the objectives of adaptation (adaptation for forest and forest for adaptation). The design and implementation of technical measures for forest adaptation depends on a favorable institutional environment, characterized by strong networks and partnership building, knowledge generation and dissemination, and strategies for reducing socioeconomic pressure on forest resources (Locatelli *et al.*, 2008). Furthermore, regional and national institutional frameworks should create opportunities for building local level networks, collective action and social capital which are relevant for the adaptation of local forest communities (Peach-Brown *et al.*, 2014).

Photo 4.6: Artisanal exploitation and transformation in the heart of the forest

Future climate change and forest vulnerability is characterized by uncertainty and the dynamics of human-environmental systems. Thus, policy and institutional approaches should be diverse, flexible, adaptive and continuous to take advantage of knew knowledge and insights (Bele *et al.*, 2014). Building policy-science dialogue is necessary. Findings generated by rigorous research should be transformed into policy relevant language and put into the policy process. Science should inform decision makers about assessing vulnerabilities, identifying response options and designing adaptation strategies. Decision makers in the region need frequently updated information and knowledge to support regional and national positions on climate change adaptation (Tiani *et al.*, 2015).

3.2. Regional, national and sub national initiatives

Adaptation initiatives refer to initiatives whose outcome has intentions to support national adaptation policies and strategies. They include impacts and vulnerability assessments, identification of country priorities, planning for adaptation, implementing large adaptation programs, monitoring and evaluating adaptation interventions, and capacity building (Pavageau and Tiani, 2014). At the international level, adaptation initiatives are demonstrated through NCs, NAPAs and NAPs. Almost all COMIFAC countries have submitted the first and second NCs and NAPAS, with Gabon to be the first to complete the Intended Nationally Determined Contribution (INDC) including a chapter on adaptation (Table 4.2). Eligible COMIFAC LDCs countries have submitted a total of about 70 projects cutting across different sectors and levels. A limited number of these projects (9 %) explicitly take into consideration adaptation for forest and the role of forest for the adaptation of local communities (UNFCCC, 2015d). This might be due to the fact at the time of developing NAPA priority projects, COMIFAC countries had limited information and knowledge on the vulnerability of forest ecosystems to climate change and the role of forests for adaptation.

Apart from the initiatives emanating from the international level, other regional and national level initiatives exist which originate from bilateral and multilateral arrangements (Pavageau and Tiani, 2014). The COBAM and CoFCCA projects implemented by CIFOR provided early insights on the policy and local level challenges and opportunities of climate change vulnerability and adaptation in the context of forest ecosystems use and management in the Congo Basin. However, further research is required to generate and disseminate useful information on the short and long-term climate variability. This is relevant for anticipating impacts on climate sensitive activities, sectors and development planning for the Central Africa region.

Table 4.2 : Status of national adaptation strategies of COMIFAC member countries in the UNFCCC process.

Countries	1st NCs	2nd NCs	NAPAs	INDCs
Burundi	2001	2010	2007	-
Cameroon	2005	-	-	-
CAR	2003	2015	2008	-
Chad	2001	2013	2010	-
Congo-Brazzaville	2001	2009	-	-
DRC	2000	2009	2006	-
Equatorial Guinea	-	-	2013	-
Gabon	2004	2011	-	2015
Rwanda	2005	2012	2007	-
Sao Tomé and Principe	2005	2012	2007	-

Sources : UNFCCC 2015a, 2015b, 2015c.

3.3. Ecosystem-based adaptation : a potential response in Central Africa ?

Ecosystem-based adaptation (EbA) is defined as "the use of ecosystems to support societal adaptation through their management, conservation, and restoration to provide services that enable people to adapt to the impacts of climate change. It aims both at increasing the resilience and reducing the vulnerability of ecosystems and people in the face of climate change" (UNEP, 2009). EbA strategies range from sustainable water management for water storage, flood regulation and coastal defenses, disaster risk reduction through tree cover, sustainable agriculture using locally available genetic resources, etc. (de Wasseige *et al.*, 2014).

The Congo Basin is characterized by a large forest cover with up to 2,874,419 km^2 of humid and dry forest altogether in 2015 (see chapter 1). Although still vulnerable to climate change, forest presents a bigger relative adaptive capacity as compared to other ecosystems due to their specific composition. This is particularly evident for tropical forests that are richer in biodiversity than temperate forests (Locatelli *et al.*, 2008).

Governments in the sub-region are still struggling to push their development strategies. Planning for adaptation involves investing in uncertainties, and maladaptation could provide counterproductive medium-term outcomes. Ecosystem-based adaptation appears as a cost-effective option with significant social, economic and environmental co-benefits (UNEP, 2009). Furthermore, in a region with high mitigation potential the donors concentrate their focus on carbon conservation, with adaptation financing focusing on arid and semi-arid regions. Finally, EbA is more accessible to the rural poor than infrastructure and engineering-based adaptation. With a 54 % the total population living in rural areas in Central Africa, EbA seems as a likely alternative (UN, 2015).

Photo 4.7: Will the forest return on this cleared land ? This is one of the major issues related to REDD

4. Measuring and monitoring the impacts of adaptation measures

Adaptation to climate change in the forest sector involves measures designed for implementation at the local or project level, and policy level measures. At the project level, adaptation takes place in three sequential steps. Firstly, it requires the climate vulnerability and impact assessment of forest and forest peoples. This step consists of analyzing the context, describing current climate and forest conditions and developing scenarios of future climate change and forest conditions. Second, it requires the design and implementation of adaptation measures. Third, it requires the measuring and monitoring of the impacts of adaptation measures. Indicators on the vulnerability and impacts needs to be developed during the first step, permitting planning and targeted implementation and the measurement and monitoring of the impacts of adaptation actions. Due to the novelty of adaptation programs most of the sets of indicators developed until now belong to the first level, vulnerability. The links between climate change vulnerability and poverty have allowed borrowing from development planning and implementation approaches (Box 4.2).

Box 4.2: *Climate vulnerability indexes used in Africa.*

Over 20 groups of indicators (indexes) have been developed by scientists, governments and development organizations in order to identify vulnerable areas in Africa. Most of them follow the IPCC approach to vulnerability by considering a combination of exposure, sensitivity and adaptive capacity aspects. These indexes are constructed using cross-disciplinary indicators, covering different sectors, scales and groups of populations, based in either past climate trends or climate projections. Besides the uncontestable utility of cross-regional indexes for policy and development planning, vulnerability analyses are very dependent on the type and quality of data used and they need to be used with caution. Pavageau et al (2013) analyzed the typology of indexes to find out commonalities and approaches among them (Figure 4.3). As a result, four major groups were identified : indexes focusing on agriculture and poverty (Group 1), indexes focusing on population density (Group 2), indexes focusing on governance (Group 4), and other indexes (Group 3). Very few consider the vulnerability of forests themselves, most of them taking them into account either as a source of adaptive capacity (safety nets) or as a potential source of conflict over resource management. Country vulnerability assessments are very disparate depending on the index used. Generally, Gabon appears as resilient for most of the indexes whereas Cameroon, Chad and CAR are very dependent on the focus of the vulnerability analysis. Congo, DRC, Rwanda and Burundi are sometimes classified as highly vulnerable, whereas for other indexes there are not sufficient data available.

In the forest sector, designing indicators for monitoring and measurement could be challenging as a result of the links between the three variables of forest, climate change and forest peoples. In this context, further research is required to develop and test a comprehensive set of tools which can be adapted to different situations in the region. Whatever be the approach for evaluating adaptation measures, evaluation should be considered as a continuous process, in order to modify adaptation strategies that are not responding to objectives, and to take advantage of new information on climate change impacts on forest and forest peoples. Furthermore, there is a clear need for institutions leading data collection to obtain and centralize more locally relevant and continuous data. Several countries have expressed their interest in the creation of National Climate Change Observatories like Cameroon, Chad, Gabon, and Rwanda but they still need to be made operational. Others have delegated the responsibility to existing institutions like Burundi and Sao Tomé & Principe.

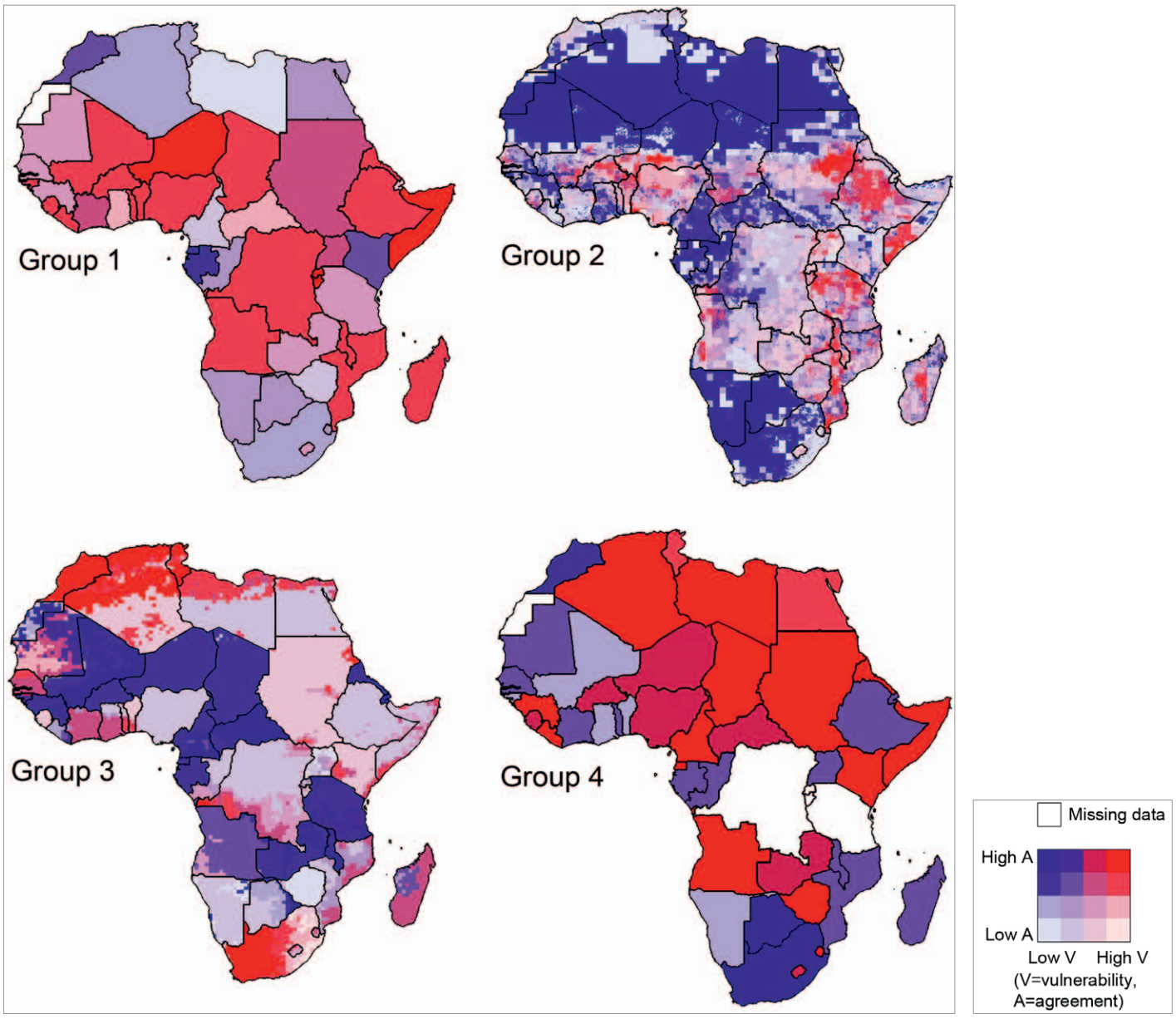

Figure 4.3: Aggregate vulnerability maps for each group of indices across African countries
Source: Pavageau et al., 2013

5. Lesson learnt from early initiatives on adaptation

Adaptation initiatives in Central Africa and developing countries of other continents can provide useful insights for future planning in Central Africa. Ranging from governments to the grassroots, different stakeholders have fostered adaptation initiatives. NAPAs have been compiled, although not yet funded, and therefore, most observations come from international and subnational initiatives. In addition, best practices can be obtained from unintentional adaptation to past extreme events and common variability by local farmers can also help designing future programs (Füssel, 2007; Twomlow, 2008). Some lessons learned from initiatives on adaptation in the region are quoted as follows:

1. Adaptation measures are not rigid or definite. They involve actions that target several aspects of climate stimuli, from extreme events, variabilities to changes in means. Both natural

climate variability and anthropogenic climate change need to be considered, as the combination of both can lead to increased impacts. Combinations of coping strategies and proactive/resilience improvement can help in efficiently responding to climate change (e.g. reconstructing a building after an extreme event vs. creating climate insurance schemes that cover the costs) (Ford *et al.*, 2014 ; Füssel, 2007).

2. Adaptation planning includes managing the risk of uncertain and complex hazards. It therefore needs to remain flexible through time, as future threats might vary. Projects need then to include mechanisms of continuous monitoring and evaluation. More accurate climate projections through specialized centers will reduce the costs of adaptation projects.

3. Adaptation to climate change needs to be made context specific, because it depends on a large combination of factors. Diversifying the types of actions and scales can contribute to better adaptation. Costly adaptation measures should be thoroughly evaluated (see box 4.3) whereas no-regrets actions can be easily incorporated in policies. UNDP and UNEP have supported existing institutions at different scales across countries, by merging large and small replicable actions that are in line with national policies (Nkem *et al.*, 2011).

4. Whereas inclusiveness of different stakeholders, subnational scales and marginal groups in the design and implementation of climate change policies has proved an increase in the efficiency and effectiveness, many projects still fail to do so in Central Africa (Mai *et al.*, 2011 ; Ford *et al.*, 2014). Strengthening social networks have provided positive outputs in other African countries (IPCC, 2014). Furthermore, it can increase the sustainability of project results through increased appropriation. Adaptation planning requires contribution of climate specialists, decision-makers and practitioners. Both men and women should be actively involved in the conceptualization and implementation of adaptation actions. In many occasions, project planners have confronted transaction costs and deficient communication schemes that reduce the possibilities for public consultations (Tschakert and Dietrich, 2010).

5. Adaptation needs to be combined with mitigation, as it cannot cover all aspects of climate change due to the complexities in planning and implementation.

Photo 4.8: The village consultation is necessary for the success of projects in rural areas

Box 4.3: *Choosing adaptation options*

Anticipatory adaptation if:
– climate-sensitive risks are already urgent;
– increasing risks are projected reliably;
– future impacts are potentially catastrophic or irreversible;
– decisions have long-term effects; and/or
– adaptation measures have a long lead time.

Postponing adaptation if:
– current and anticipated future risks are moderate;
– adaptation is very costly; and/or
– timely response options are readily available.

Source: Füssel (2007)

Photo 4.9: Strategy of passive self-defense. But nothing will stop the man if he wants to make use of this tree

6. Challenges and the way ahead

The major challenge for the COMIFAC countries is to develop climate change adaptation strategies for the transboundary forest system, without endangering the integrity for these forests to ensure the continuous provision of ecosystem goods and services critical for community livelihoods, national development and the economic growth of the region. At the present, there is insufficient knowledge on regional climate change patterns, unknown quality, quantity, and spatio-temporal pattern of risk occurrence and the lack of clear adaptation possibilities. There is a real need to enhance climate change information generation and its delivery through the improvement of climate change information infrastructure e.g. weather/meteorological stations and technology, and information centralization, delivery and sharing services. Notwithstanding, the dynamic ecological, economic, social and political pathways provide opportunities for COMIFAC countries to develop viable adaptation strategies.

There is a need to move from cross-continental analysis to sub-regional, since the ecological and socio-economic settings vary greatly across countries. Regional structures and platforms like COMIFAC, CBFP, CICOS, LCBC, ECCAS, and regional civil society networks need to further insist in transmitting this message. They have the potential to boost adaptation mainstreaming in national policies, through the provision of guidelines, funding and coordination (de Wasseige *et al.*, 2014). In this sense, NAPAs and adaptation provisions in NCs and INDCs are still to be operationalized. Since government cannot count solely on external funding, no-regrets adaptation is advised. Increase climate change adaptation in the national and regional policy spaces, by raising policy and public awareness on climate change, and reflecting on the need for adaptation. Harness the regions carbon potential not only for climate change mitigation, but for achieving sustainable economic growth, poverty reduction and climate change adaptation. Balance the interest of multiple stakeholders when setting priorities intended to achieve the national economic growth, environment and social sustainability objectives. Improve ecological safety nets in forests so that valued resources are more resilient to climate variability and change. Improve science- policy dialogue, with a broad public participation (Nkem *et al.*, 2008).