



Implemented by



Sustainable Water Resources Management in the Lake Chad Basin

Module “Adaptation to Climate Change”

REGIONAL STRATEGY FOR ADAPTATION TO CLIMATE CHANGE

Agriculture Livestock Fisheries

Diagnostic Analysis



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EXECUTIVE SUMMARY

Since the 20th century, climate change in the Lake Chad Basin has been characterized by a strong interannual variation. It is characterized by two phases:

- A generally humid phase from 1901 to 1960, punctuated by dry years during the 1910, 1920 and 1940 decades;
- A generally dry phase since 1960, interrupted from the 1990s by a recovery in rainfall with lower amounts of rainfall than at the beginning of the century. This recovery has not allowed the lake to return to its size in the 1960s.

Temperatures have generally increased since 1940. Projections have shown that the 120-day vegetative line will descend southward due to its dependence on temperature, evapotranspiration and precipitation. According to scenario A1, by the end of the century, 70,960 km² of land will lose their agricultural potential. Under scenario A2, large areas of the territory will be classified as having low agricultural potential. Due to the gradual southward migration of the 120-day line, about 135,150 km² will experience climatic conditions that will not allow the development of agriculture without adaptation (GIZ, 2015).

No significant difference in temperature increase will be observed between the scenarios until the end of the 2030s. But, from that date on, the difference in variation between the scenarios will be noticeable. Thus, scenario B1 forecasts a relatively lower temperature increase. In this scenario, average annual temperatures will have increased by about 2°C, with 0.5°C more or less depending on the climate zone. According to scenarios A1b and A2, temperatures will increase more rapidly in the early 2040s, leading to a total increase of 3°C (A1b) and 4°C (A2) in 2099. The increase predicted by these scenarios would follow the pattern of spatial and temporal variation observed between 1973 and 2013: increase in maximum temperature in September-October-November and March-April-May and increase in minimum temperature in June-July-August and January-February-May.

The main extreme weather events in the Lake Chad Basin are mainly related to precipitation, temperature and wind (droughts, floods, extreme temperatures, high winds and sandstorms). These factors also lead to certain risks such as erosion, bush fires, locust attacks. Locust invasions are favored by the succession of years with wetter climatic conditions in the hyper-arid zone of the basin. According to the analysis of observed or projected climate variability and change (climate scenarios), the trend of these phenomena is increasing.

Vulnerability studies conducted in countries have shown that fluctuations in cereal yields are linked to many factors, among which rainfall variability is the most important. In both the Sahel and Sudan areas, the dry years of the 1970s, 1980s and even the decade of the 2000s have seen a decline in yields and the southward shift of the cotton zone. Significant losses of livestock and livestock migration to the south have also been reported.

Whether the dry scenario (generally dry trends with less than normal annual rainfall in the reference period) or the wet scenario (generally wet trend with annual rainfall above normal in the reference period) is selected, the extreme weather conditions (droughts and floods) that will occur will affect agricultural, pastoral and fish production. Sand encroachment and silting of water bodies and rivers, the proliferation of invasive aquatic plants, the reduction of spawning grounds and the decrease in the diversity of fish fauna will affect fishing production.

The basin's capacity to adapt to climate change in the agricultural, livestock and fish farming sectors is weak. Agriculture, livestock and fishery sectors contribute to between 20% and 57% of the GDP of the member countries and employ more than 50% of the active population in the basin. The incidence of poverty is high: between 28 and 76%. The low budget allocated to these sectors (5.2%, well below what is recommended by the Maputo Declaration of 12 July 2003, according to which the budget of ministries involved in agriculture in the broad sense should reach 10% of national budgets) will not facilitate a satisfactory supervision of producers by the decentralized services. Also, the low use of both organic and mineral manure (10% to 77% depending on the regions or Federated States), the limited access of producers to animal or mechanical traction (10% to 58%) and vaccines (20% to 60% of the cattle population is regularly vaccinated) are factors that increase sensitivity to climate shock.

To mitigate the effects of climate change on populations, the countries of the basin have strategic adaptation documents (NAPA, NAPs). These documents have made efforts to cover the vital sectors of the economies and are in line with the objectives and priorities of the National Poverty Reduction Strategies. Particular attention has been paid to the rural sector; most projects/programs focus directly or indirectly on rural activities (09 projects in Niger and Chad, 08 programs in Cameroon and Nigeria and 04 projects in CAR). However, the attention given to cross-border water management issues and sub-regional cooperation regarding observations and forecasts, dissemination of context-specific varieties and conservation management techniques for water and soil varies between the countries.

The United Nations Framework Convention on Climate Change (UNFCCC) adopted and opened for signature in 1992 at the Rio de Janeiro Conference, is the international framework for adaptation to climate change. The highest authority of the UNFCCC is the Conference of the Parties (COP), which brings together all signatory countries each year to take decisions on the implementation of the Convention. All LCBC member countries have signed and ratified the UNFCCC and have put in place their National Climate Change Adaptation Frameworks. In Cameroon, Nigeria and Chad, one of the directorates or sub-directorates of the Ministry in charge of the environment is the UNFCCC focal point that develops and coordinates CCA Climate Change Adaptation (CCA) policies. In CAR, the Ministry of Agriculture and Rural Development oversees the issue pending the operationalization of the National Commission for Environment and Sustainable Development (CNEDD). In Niger, the National Environment Council for a Sustainable Development (CNEDD) manages adaptation issues.

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2 nd COM_ Cameroon	Republic of Cameroon: Second National Communication under the UNFCCC
2 nd COM_ CAR	Central African Republic: Second National Communication under the UNFCCC
2 nd COM_ Chad	Republic of Chad: Second National Communication under the UNFCCC
2 nd COM_ Niger	Republic of Niger: Second National Communication under the UNFCCC
2 nd COM_ Nigeria	Republic of Nigeria: Second National Communication under the UNFCCC
3 rd COM_ Niger	Republic of Niger: Third National Communication under the UNFCCC
ACMAD	African Centre of Meteorological Applications for Development
ADB	Asian Development Bank
AEDE	Agency for Domestic Energy and Environment, Republic of Chad
AF	Adaptation Fund
AGRHYMET	Regional Centre for Training and Applications in Agrometeorology and Operational Hydrology
AIACC	Assessments of Impacts and Adaptations to Climate Change
ANGMV	National Agency for the Great Green Wall, Republic of Chad
ANR	Assisted natural regeneration
AU	African Union
CAPV-2C	Project: Contribution for Population Mitigation and Adaptation to Climate Variability and Change
CAR	Central African Republic
CC	Climate Change
CILSS	Permanent Interstate Committee for drought control in the Sahel
CMS	Cameroon Maize Series
CNEDD	National Committee for Environment and Sustainable Development, Republic of Niger
COMIFAC	Central African Forest Commission
COP	Conference of Parties
CSE	Ecological Monitoring Centre, Senegal
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTCVC	Technical Commission of Climate Change and Variability, Republic of Niger
CTD	Decentralised Territorial Authorities, Republic of Cameroon
DLCCC	Department of Climate Change Control, Republic of Chad
DNA	Designated National Authority
DWD	Deutscher Wetterdienst (German Meteorological Service)
ECCAS	Economic Community of Central African States
EcoQOs	Ecological Quality Objectives
ECOWAS	Economic Community of West African States
ECVR	Survey on Living Conditions in Rural Households, Central African Republic
ECVU	Survey on Living Conditions in the Urban Households, Central African Republic
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FNE	National Water Fund, Republic of Chad
FSE	Special Environmental Fund, Republic of Chad

GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GFDL	Geophysical Fluid Dynamics Division of the National Oceanic and Atmospheric Administration, USA
GIR	Rural Interest Group
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (German Corporation for International Cooperation)
GPCC	Global Precipitation Climatology Centre, USA
IDB	Islamic Development Bank
IFAD	International Fund for Agricultural Development
INDC	Intended Nationally Determined Contributions
INS	National Institute of Statistics
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
IRAD	Institute of Agricultural Research for Development
IWRM	Integrated Water Resources Management
KIDP	Kano Irrigation Development Project, Republic of Nigeria
LCBC	Lake Chad Basin Commission
LDCF	Least Developed Countries Fund
MAG	Ministry of Agriculture
MCA	Multicriteria Analysis
MEL	Ministry of Livestock
MHE	Ministry for Hydraulics and the Environment
MINEPAT	Ministry of Economy, Planning and Regional Development, Republic of Cameroon
MINEPDED	Ministry of Environment, Nature Protection and Sustainable Development, Republic of Cameroon
MINFI	Ministry of Finance, Republic of Cameroon
MME	Ministry of Mines and Energy, Republic of Niger
MPI	Max Planck Institute, Germany
MRI	Meteorological Research Institute, Japan
NAP	National Climate Change Adaptation Plan
NAPA	National Adaptation Programme of Action
NASPA-CCN	National Adaptation Strategy and Plan of Action on Climate Change for Nigeria, Republic of Nigeria
NBS	National Bureau of Statistics, Republic of Nigeria
NCDC	National Climatic Data Center, USA
NCRE	National Cereals Research and Extension Program, Republic of Cameroon
ONAC	National Observatory on Climate Change, Republic of Cameroon
ONCC	National Observatory on Climate Change, Republic of Chad
ONDR	National Office for Rural Development, Republic of Chad
PAPNCC	Pan-African Parliamentarians Network on Climate Change
PCVC	Climate Change and Variability Program, Republic of Niger
PET	Potential evapotranspiration
PNACC	Plan National d'Adaptation aux Changements Climatiques du Cameroun
PNEDD	National Plan on Environment for Sustainable Development, Republic of Niger
PNSA	National Food Security Programme, Republic of Chad
PPBS	Planning Programming Budgeting System

PRESAO	Seasonal Forecasting Program in West Africa
PRESIBALT	Program for the Rehabilitation and Strengthening of the Resilience of Socio-ecologic Systems of the Lake Chad Basin
PRODEBALT	Lake Chad Basin Sustainable Development Program
REDD	Reducing Emissions from Deforestation and Forest Degradation
REPAR	Network of Parliamentarians for Sustainable Management of Forest Ecosystems in Central Africa
REPIMAT	Chadian National Animal Disease Epidemio-Surveillance Network, Republic of Chad
RGAC	General Census of Agriculture and Livestock, Republic of Niger
ROSE	Network of local NGOs in South-Eastern Cameroon
SAFGRAD	Semi-arid, Food Grain Research and Development Coordination Project
SAP	Strategic Action Plan
SCCF	Special Climate Change Fund
SCCU	Special Climate Change Unit, Republic of Nigeria
SCIP	South Chad Irrigation Project, Republic of Chad
SDLEEH	Master Plan for Siltation Water Erosion Control in the Lake Chad Basin
SEMRY	Society for the Expansion and Modernisation of Rice Production in Yagoua, Republic of Cameroon
SOB	Report on the State of the Lake Chad Basin Ecosystem
SODECOTON	Cotton Development Corporation, Republic of Cameroon
SODELAC	Lake Chad Development Corporation, Republic of Chad
SPA	Strategic Priority on Adaptation Program
SWC/SPR	Soil and Water Conservation/Soil Protection and Restoration
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
WMO	World Meteorological Organization

0 INTRODUCTION

0.1 Presentation of the Lake Chad Basin

The Lake Chad hydrographic basin is located between Central and West Africa. It extends from 6 to 24 degrees northern latitude and from 8 to 24 degrees eastern longitude and covers an area of 2,434,000 km² divided between Algeria, Cameroon, Central African Republic (CAR), Chad, Libya, Niger, Nigeria and Sudan. The conventional basin covers an area of 967,000 km², which is about 40% of the hydrographic basin. It is distributed as follows: the Chadian part of the conventional basin constitutes about 34% of the total area (361,980 km²), the Cameroonian part 6% (56,800 km²), the Nigerien part 17% (162,375 km²), the Nigerian part 19% (188,000 km²) and the CAR part 22% (197,800 km²). The basin relief is largely flat, composed of a peneplain with altitudes varying between 300 m and 500 m, surrounded by highlands (from 1,300 m to 1,900 m) in Nigeria's northern center, in the Adamawa Plateau in Cameroon and in the northern part of the CAR (Figure 1).

It is an endorheic basin formed by the lake itself and by the rivers that flow into it. These are: the Chari River which flows from the mountain ranges located in CAR (Bongo Massif) and Darfur (Sudan); the Logone River which originates in the Adamawa mountains of Cameroon and in the Karre Mountains of the Central African Republic; the Komadougou-Yobe River which originates in Nigeria and forms a section of 160 km of the border between Nigeria and Niger. The rest of the hydrography is represented by temporary rivers: the Serbewel (a distributary flowing out of the Chari River, downstream of N'Djamena), the El-Beid River, flowing in from the Yaere plain as well as the Ngadda and Yedseram Rivers which come from northern Nigeria and the Mandara Mountains in Cameroon, respectively.

The main soil types found in the Lake Chad Basin are ferralitic and wind-derived underdeveloped raw mineral soils, isohumic (or subarid) soils, ferruginous tropical soils, hydromorphic soils, halomorphic (or salsodic) soils and vertisols. These soils are generally low in organic matter and have deteriorated over time with agricultural practices. Water erosion and hardening processes have changed the physical quality of these soils as a result of slash-and-burn farming practices and deforestation.

The climate of the Lake Chad Basin is generally of a hyper-arid tropical type, but it includes four variants corresponding to different types of isohyets. Total annual rainfall decreases from south to north, ranging from 1,500 mm/year to 100 mm (SOB, validated in 2016). This spatial variability of climate is accompanied by a great diversity of habitats, including desert landscapes, shrub-steppe zones, savanna and forest areas, wetlands and mountains. In 2012, the total population for the entire Lake Chad Basin was estimated at 45 million inhabitants (37 million in 2002, according to the UNDP), with the majority living in large cities. It represents nearly 20% of the total population of the six countries.

DELIMITATIONS IN THE LAKE CHAD BASIN



Figure 1: Delimitations in the Lake Chad Basin

The population growth rate is high and ranges from 1.5 to 3.7% per year depending on the country. Most of the population lives in rural areas. Indeed, over 50% of the population in each country (51% in Nigeria, 61% in Niger, 78% in Chad and 82% in CAR) except in Cameroon (48%) and in Libya (22%) lives in rural areas. This population is also young: the proportion of the population under 15 is 52.3% in the Chadian part of the basin, 51.56% in the Nigerien part, 47.09% in the Nigerian part, 47% in the Cameroonian part; 49.4% of the inhabitants are under 18 in the Central African part.

The agricultural sector is a major source of employment for the countries of the basin. It employs between 26 and 84% of the countries' active population, 36 to 56% of whom are women. Producers practice *rainfed farming* during the rainy season, *flood recession farming* along rivers, lowlands or flood plains with a strong dependence on the presence of rivers or lakes and *irrigated agriculture* in large developed areas and on small areas spread along rivers or around lakes.

The livestock sector is as productive as agriculture and is one of the cornerstones of the basin's economy, after oil or mining. The activity is mainly based on mobility with transhumant livestock farming and pastoral nomadism dominating. The Sahel region remains the leading livestock region, but all regions are now involved to varying degrees. According to *FAOSTAT, 2014*, the livestock population, estimated at more than 200 million head, is mainly made up of cattle, camels, goats and sheep. A rare species of cattle, the "Kouri" cow, is indigenous to the pastures of Lake Chad.

Fishing is one of the most common activities in the Lake Chad Basin, particularly in Lake Chad, reservoirs, flood plains and river systems in the basin, especially during periods of high rainfall. In 2012, the estimated fish production of the lake was about 100,000 tonnes. The fishing industry is a source of income for more than 200,000 people in the basin. The fishing communities around Lake Chad are generally Kotoko, Mousgoum, Massa, Arabs, Boudouma, Kanembou, Toupouri, Sara, Haoussa, Kanuri and West Africans.

0.2 Objectives of the diagnostic analysis

The objective of this study is to provide an overview of climate change, its adverse effects on the agropastoral and fisheries sectors and the ongoing adaptation policies in the Lake Chad Basin.

More specifically, the objectives are to:

- Analyze the vulnerability of the agropastoral and fisheries production sectors to the adverse effects of climate change;
- Identify cross-border needs in climate change adaptation in these sectors; and
- Analyze national climate change adaptation policies implemented by LCBC member countries.

0.3 Methodology

Team

A team of nine members was set up to carry out this study. It is composed of an agronomist, a forestry expert, a wetland expert, a socio-economist, a climate change expert, a fisheries expert, a monitoring and evaluation expert, a gender expert and a modeler and is placed under the supervision of the Director of the Program "Sustainable Water Resources Management in the Lake Chad Basin" and the LCBC Technical Director.

Data collection

The study is based on the literature review, the study of climate change in the Lake Chad Basin and the inventory of the main agricultural production systems in the pilot area carried out by the project.

The documents used for this purpose are the LCBC and member countries' climate change adaptation plans or programs, the national climate change communications, the Intended Nationally Determined Contributions (INDC), the project/program documents of the LCBC, the report on the transboundary diagnostic analysis of the Lake Chad Basin and the reports of studies on climate change and adaptive capacities carried out in the basin.

Analysis

The approach of the analysis of the vulnerability of agriculture, livestock and fisheries to climate change is based on an assessment of

- the exposure to climate change and variability in the basin;
- the sensitivity of these sectors to climate change and variability;
- the adaptive capacities of producers.

The approach also highlighted cross-border climate change issues. These are: climate risks to which the selected sectors are exposed, their vulnerabilities, adaptation needs and adaptation measures.

1 PART ONE: SITUATIONAL ANALYSIS OF CLIMATE CHANGE AND VULNERABILITIES IN LAKE CHAD BASIN

1.1 Climate change and vulnerability in the Lake Chad Basin

To assess climate variability and change over the past 40 to 100 years, the climate study developed by GIZ and the LCBC used different precipitation and temperature data sets. These were provided by the Climate Research Unit (CRUTEM) of the British Hadley Climate Center, by the U.S. National Climatic Data Center (NCDC) and by the Global Precipitation Climatology Center (GPCC) of the Deutscher Wetterdienst (DWD).



Figure 2: Grid displaying CRUTEM4 pixel size and location¹

1.1.1 Variability observed in temperature values between 1973 and 2013 in the Lake Chad Basin

The evolution of temperatures between 1973 and 2013 in the basin is characterized by a growing trend in all components. Throughout the basin, minimum temperatures in the periods JJA (June-July-August) and DJF (December-January-February) increased by 3-4°C; average temperatures in the periods MAM (March-April-May) and SON (September-October-November) increased more significantly. In the southern part of the basin, which is the most watered area where the main water courses flowing into the Lake Chad originate, temperature increases are the lowest during all seasons (GIZ, 2015).

In the Sahel and Sudanian areas to the east of the basin, the increase in maximum temperatures is less pronounced than the increase in minimum temperatures (NAPA-Chad). In the West of the basin, too, minimum temperatures (especially from January to March) are increasing. However, a decrease in maximum temperatures during the recent periods of severe droughts in the Sahel has been recorded (2nd COM-Niger, NASPA-CCN).

¹ Temperatures from available climate stations (red dots) are averaged across the pixel area. Numbers stand for the pixel ID in the CRUTEM4 grid.

1.1.2 Projections in temperature values between 2010 and 2099 in Lake Chad Basin

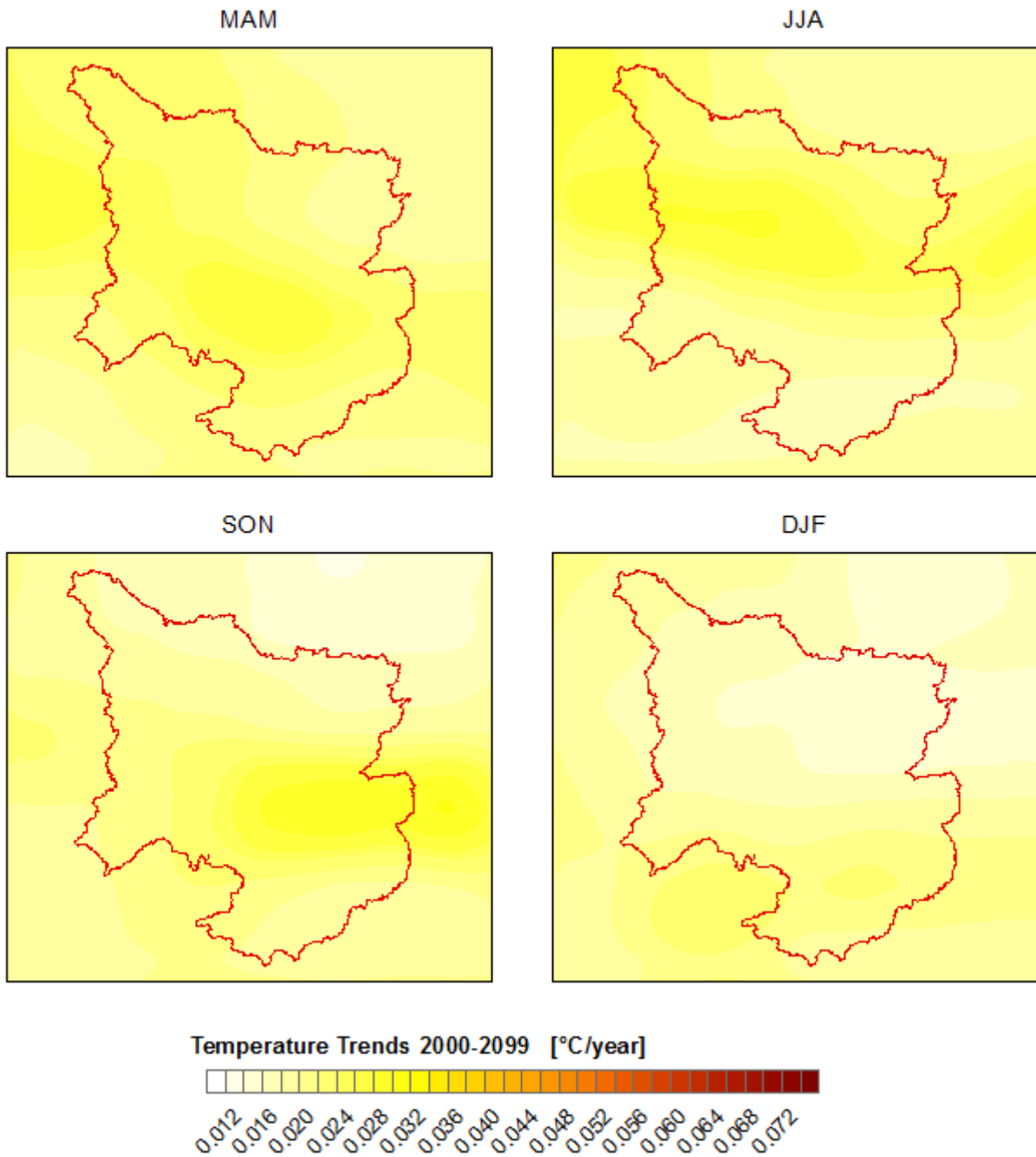
No significant differences will be observed before the end of the 2030s, regardless of the scenario applied². However, starting in the 2040s, there are marked differences in variation between the scenarios. Scenario B1 forecasts a relatively low temperature increase. In this scenario, average annual temperatures will have increased by about 2°C, with 0.5°C depending on the climate zone. According to scenarios A1b and A2, temperatures will increase more rapidly in the early 2040s, leading to a total increase of 3°C (A1b) and 4°C (A2) in 2099 (Figure 3, Figure 4, and Figure 5).

The increase predicted by these scenarios would follow the pattern of spatial and temporal variation observed between 1973 and 2013. This includes an increase of the maximum temperature in the periods MAM and SON and an increase of the minimum temperature in the periods JJA and DJF (GIZ, 2015).

It is important to note that the greatest temperature increases will occur in arid areas. In these areas, the large year-to-year differences in temperature increase are due to changes in cloud cover, which is more pronounced than in semi-arid and dry sub-humid areas (Figure 6).

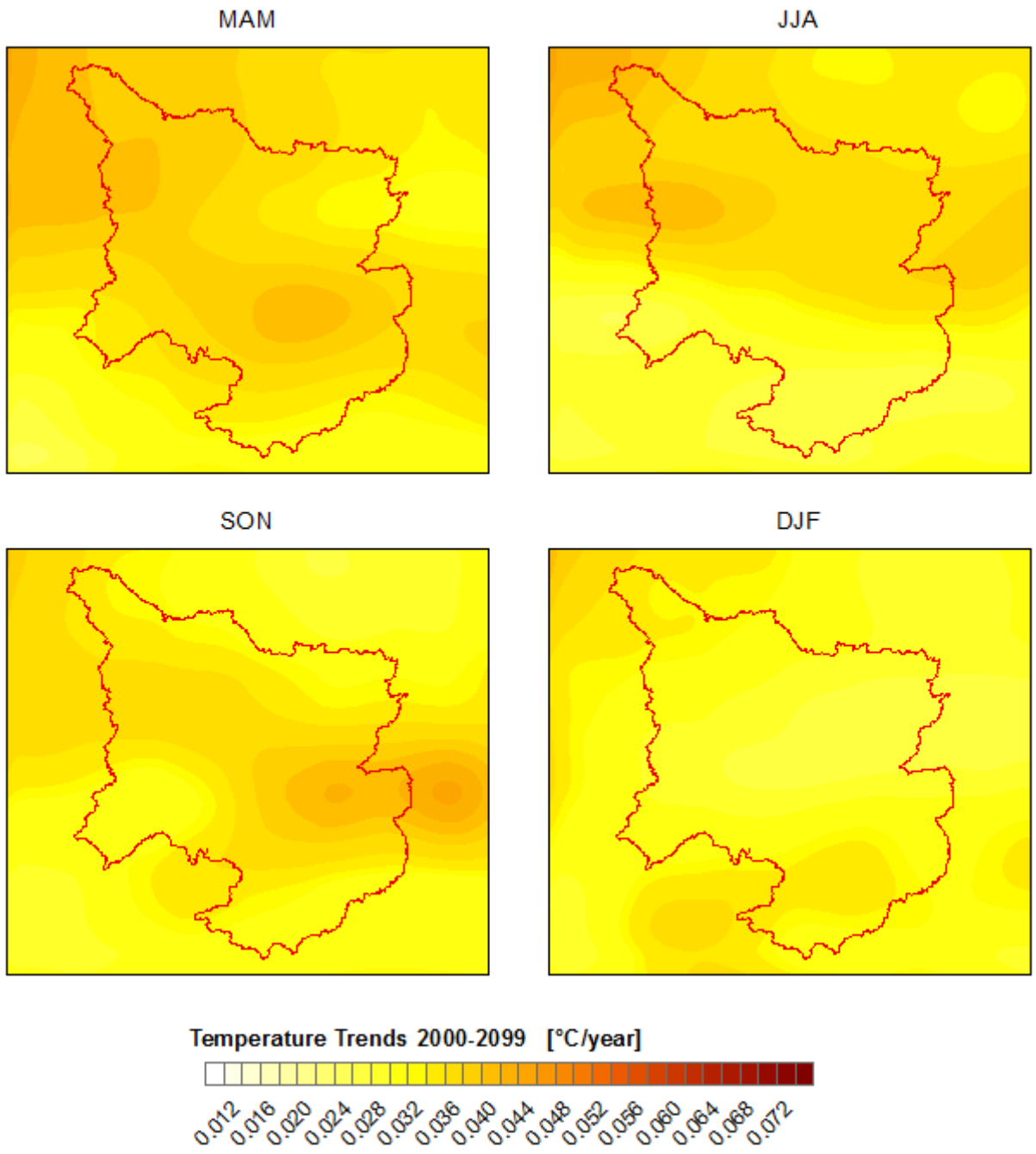
² A1b, A2 and B1

- **The B1 story line/scenario:** Follows the A1 story line (a global population that will peak in mid-century and decline thereafter), but people move quickly toward an economy based on services with a quick introduction to clean and sustainable technologies
- **The A1b (“balanced”) story line/scenario:** Very rapid economic growth, a global population that will peak in mid-century and decline thereafter and a rapid introduction of new and more efficient technologies. No excessive reliance is placed on a particular energy source, assuming that similar rates of improvement apply to all energy supply and end-use technologies.
- **The A2 story line/scenario:** The A2 story line describes a regionally fragmented economic growth, where new technologies are introduced much slower and only locally. Population growth is continuously increasing.



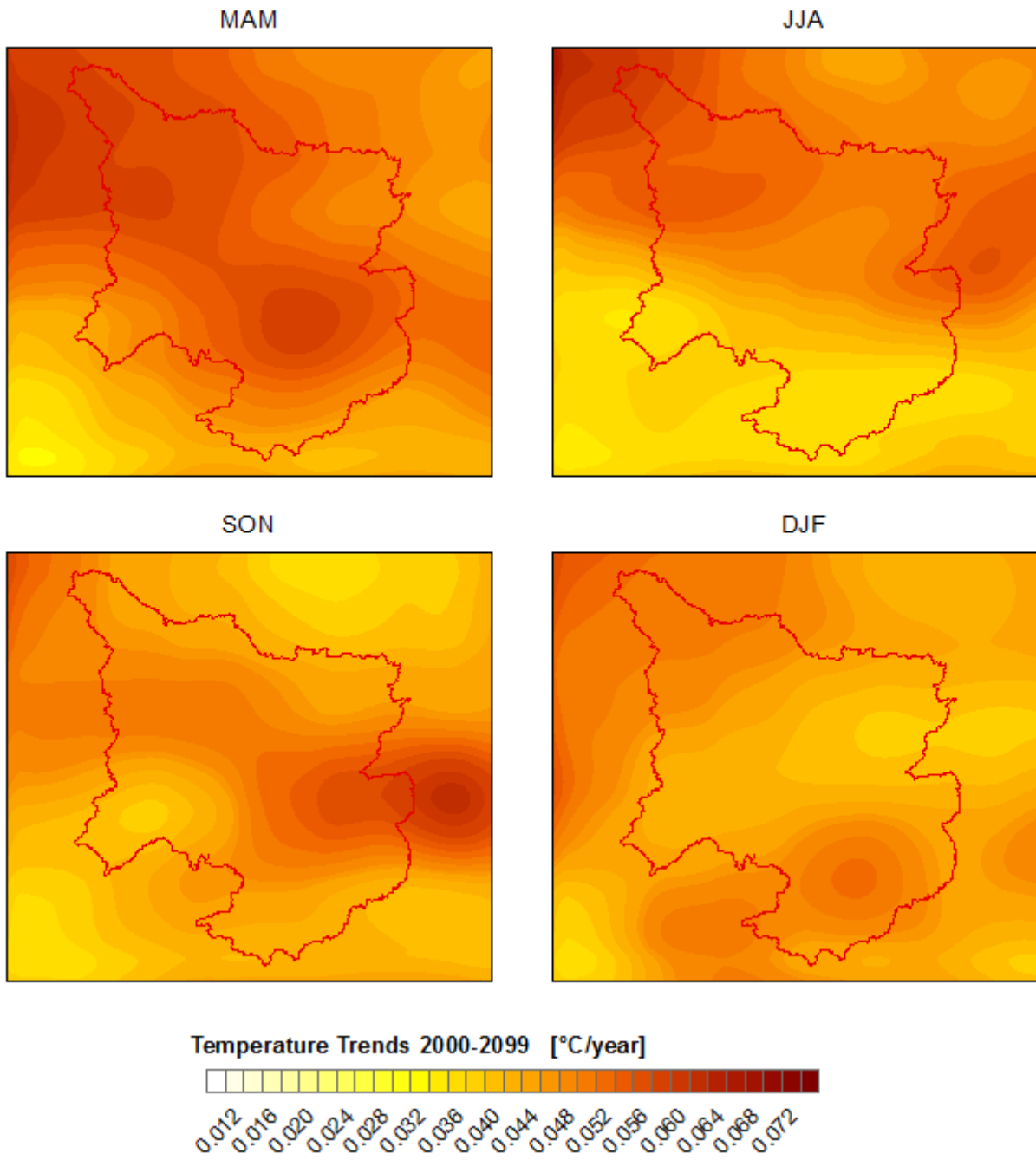
Source: GIZ/LCBC, 2015

Figure 3: Temperature increase between 2000 and 2099 in the Lake Chad Basin under B1 scenario



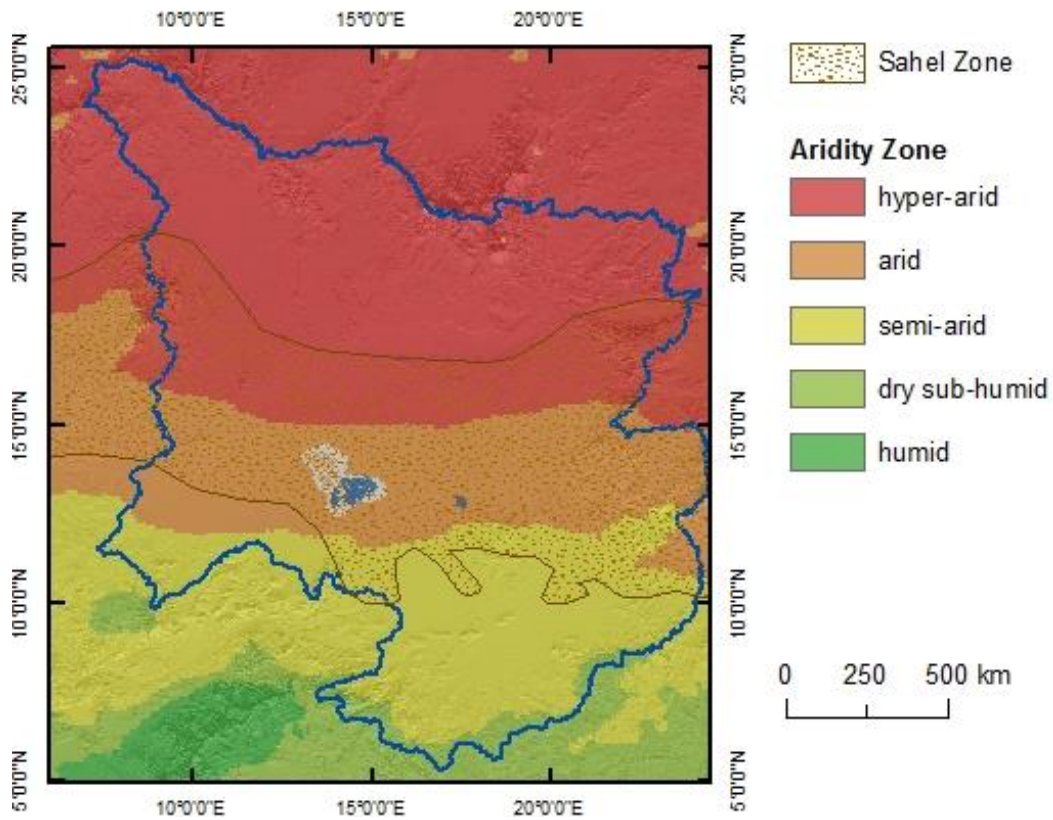
Source: GIZ/LCBC, 2015

Figure 4: Temperature increase between 2000 and 2099 in the Lake Chad Basin under A1b scenario



Source: GIZ/LCBC, 2015

Figure 5: Temperature increase between 2000 and 2099 in the Lake Chad Basin under A2 scenario

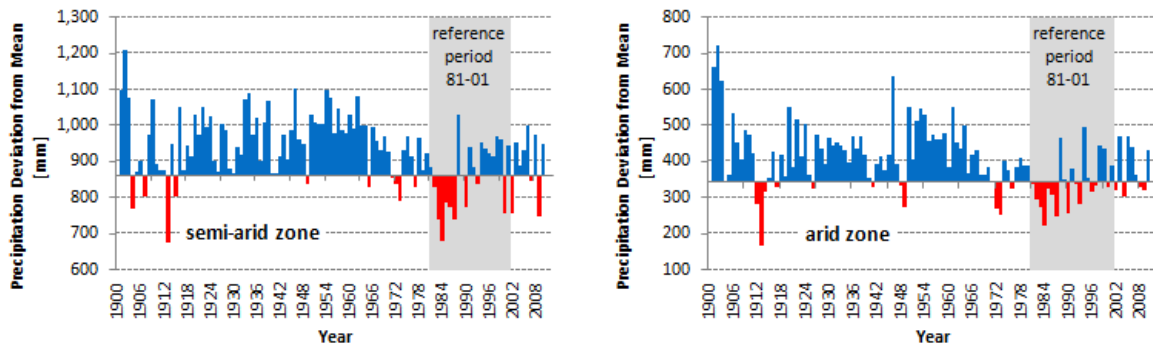


Source: GIZ/LCBC, 2015

Figure 6: Aridity zones in the Lake Chad Basin calculated as the quotient of Annual Precipitation/Annual PET

1.1.3 Observed rainfall variability between 1901 and 2010 in the Lake Chad Basin

The evolution of rainfall in the Lake Chad Basin since 1901 has been marked by a variability. It is characterized by dry years in the first two decades of the century, a surplus trend interspersed with deficit years until 1948 and a relatively stable and surplus trend during the 1950s (Figure 7). This generally humid period was followed by a generally dry phase. The dry phase was interrupted from the 1990s onwards by the return of rainfall, to a level comparable to the rainfall of the early 20th century, but with relatively lower amounts.



Source: GIZ/LCBC, 2015

Figure 7: Annual rainfall anomalies between 1900 and 2010

1.1.4 Projections of rainfall between 2010 and 2099 in the Lake Chad Basin

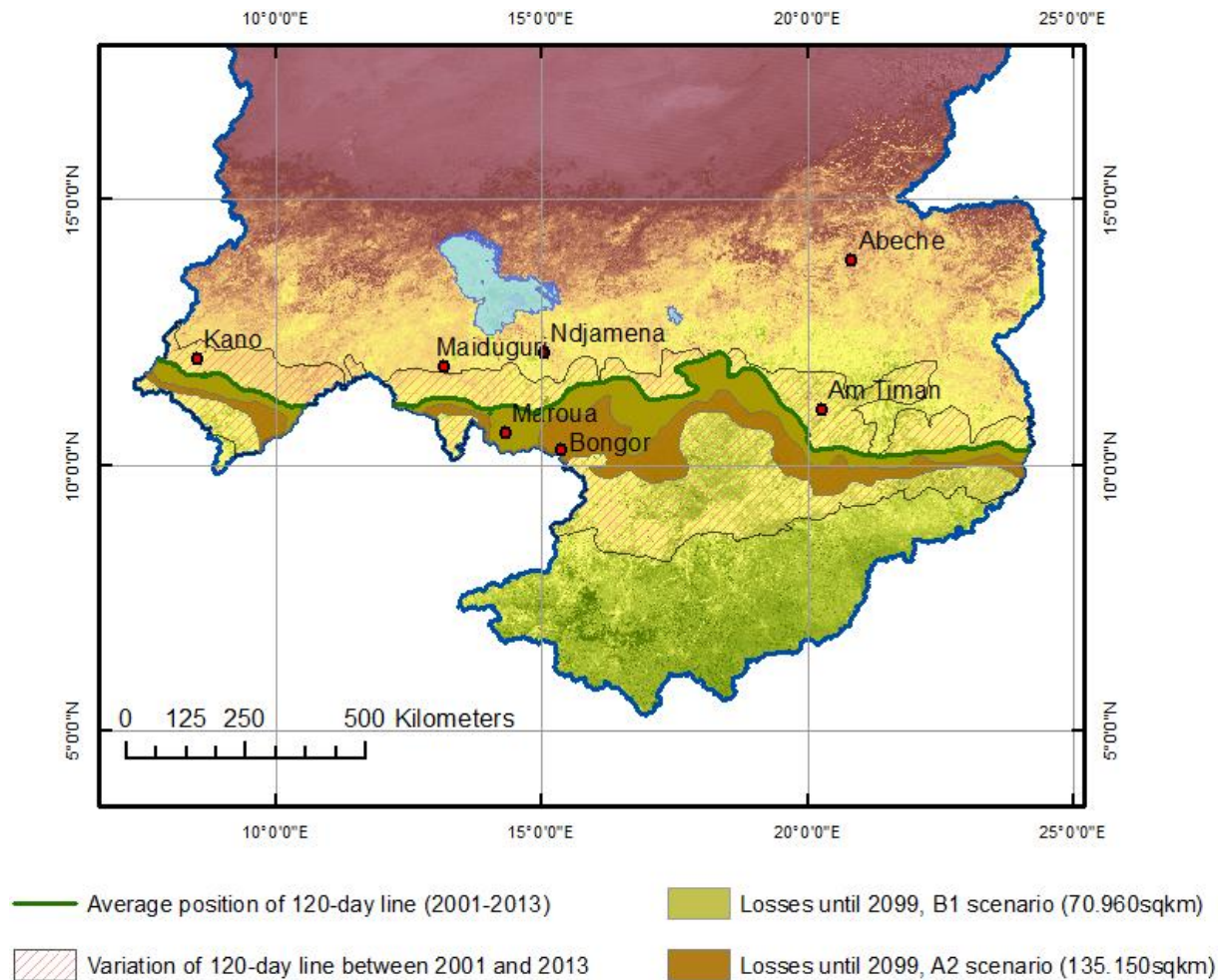
In the Western part of the Lake Chad Basin, models predict a slight increase in rainfall in northern Nigeria under scenario B1 while under B2 scenario, a decrease in rainfall from the middle of the century is expected for North-East Nigeria and the Nigerian Jos Plateau. However, near future projections for 2020 show a decrease in rainfall for the northernmost parts of the North-East (2nd COM-Nigeria). In Niger, on the other hand, two out of four models (MPI ECHAM5, CSIRO K3) predict an increase in rainfall over Niger while the other two (GFDL CM2, MRI-CGCM2) predict a decrease for 2020-2049 (2nd COM-Niger). The results obtained using these models highlight the uncertainty that characterizes the variations in precipitation predicted by the Global Climate Models (IPCC, 2007). This uncertainty reflects the lack of harmony of these models on the signs of change predicted for the dry tropical zone.

In the East of the basin, no significant change in rainfall will be observed in the Sudanese zone in 2030. A slight decrease in rainfall (about -5%) will be noticed in the Sudano-Sahelian zone. This decrease will gradually increase to reach -20% in the extreme North-East of the basin, before decreasing and reach 0 around the 19th parallel. In 2050, the inter-annual variation in rainfall will be relatively greater than in 2030. The isoline -5% which is located near the 11th parallel in 2030 will go down to the 10th parallel, the highest negative values (up to -30%) will affect not only the North-East of the basin but also the Sahelo-Saharan zone.

Except for the MPI ECHAM5 and CSIROK3 models, all models predict a decrease in rainfall and an increase in temperature. They show that extreme weather and climate events such as floods and droughts will become more frequent.

The study carried out by the GIZ and the LCBC (2015) confirms the results of the projections made in the context of the Second National Communication on Climate Change (Nigeria and Chad). The North-South dynamics of isohyets have been projected. The 120-day vegetative

line³ will experience a southward shift because of its dependence on temperature, evapotranspiration and rainfall. According to scenario A1, by the end of the century, 70,960 km² of land will lose its agricultural potential. Under the A2 scenario, large areas of the territory will be classified as having low agricultural potential. Due to the gradual displacement of the 120-day line southwards, about 135,150 km² of land will experience climatic conditions that will not allow the development of agriculture without adaptation (Figure 8).



Source: GIZ/LCBC, 2015

Figure 8: Retreat of the 120-day line under B1 and A2 scenarios in the Lake Chad Basin

³ The 120-day line is the northern limit of the area that has a vegetative period of 120 days or more during which agriculture without adaptation is possible.

1.1.5 Farmers' perception of climate variability

The results of the survey on the inventory of agricultural production systems and the local perception of climate change conducted by GIZ/LCBC (2015) in the N'Djamena-Maroua-Bongor triangle showed that these populations have a clear perception of climate change. Eighty percent of respondents have a clear position on the fact that the length of the rainy season has become shorter and marked by irregularities in the start and end dates. For more than 60% of respondents in both areas of the two countries, annual rainfall also declined with more frequent drought periods. The dry seasons have become longer and show an increase in temperature and strong winds.

1.1.6 Climate risks in the Lake Chad Basin

Extreme weather events in the Lake Chad Basin are mainly related to rainfall, temperature and wind (Table 1).

Table 1: Observed and projected climate risks

Country	Cameroon	CAR	Chad	Nigeria	Niger
Risks	Heatwaves; dust storms; droughts; floods.	Floods; decrease of rainfall; bush fires; droughts.	Droughts; floods; sand/dust storms; extreme temperatures; strong winds; locust invasions; bush fires.	Floods; droughts; dust storms; extreme temperatures; soil erosion	Floods; droughts; sand/dust storms; extreme temperatures; strong winds; locust invasions; bush fires; soil erosion.

Source: NAPA/NAP

The main hazards are droughts, floods, extreme temperatures, strong winds and sandstorms. They in turn lead to other risks, such as erosion, bush fires and locust invasions. Locust invasions are favored by the succession of wetter years in the hyper-arid zone of the basin. According to the analysis of observed or projected climate variability and change (climate scenarios), the trend of these phenomena is increasing.

1.2 Impacts of climate changes on the main rural sectors (agriculture, livestock and fishery) in the Lake Chad Basin

1.2.1 Impacts of climate changes on agriculture in the Lake Chad Basin

The main impacts of the rainfall decrease will be soil degradation, decrease of the agricultural production and food and nutrition insecurity.

In Niger, agricultural production showed a surplus until the 1970s. At the end of 1980s it covered only 86% of the domestic needs and is structurally in deficit (2nd COM_Niger).

Most of the studies carried out in CAR generally show a decrease in the production of food crops such as manioc, sorghum, corn, millet and peanut because of global warming (2nd COM-CAR).

It should be noted that climate change affects not only food crops but also cash crops. Cotton, the main industrial crop in the Sudanese and Sudano-Sahelian zone, is suffering the adverse effects of climate degradation. The cotton zone, which extended as far as the Sahel zone, gradually narrowed and is now limited to the Sudanese zone (NAPA-Chad). This decline in cotton area is largely due to the rainfall decrease marked by a decline in isohyets from north to south and to the fact that a minimum of 700 mm of rainfall is required to allow the cotton plant to complete its growth cycle.

In addition to droughts, floods have a negative impact on agricultural production. For example, in 1998 in Niger, about 588 ha of rice fields, 8,608 ha of millet fields and 203 orchards were damaged (NAPA-Niger). Similarly, in Chad in 1988 and 1998, many fields were abandoned following the floods. Furthermore, fields suffer under crop pests and diseases whose development is often caused by increased rainfall.

As in the past, future climatic conditions will have an impact on agricultural production. Recent studies by CILSS/AGRHYMET (Sarr et al. 2007, AGRHYMET, 2009) have shown that crop yields such as millet/sorghum will decrease by more than 10% if temperature increases by more than 2°C and if rainfall does not vary much by 2050. An increase of more than 3°C will result in a decrease in agricultural yields of around 15 to 25%. Global simulations (FAO, 2008) show a relatively large decrease (5 to 50%) in cereal crop yields across the Sahelian band by 2050.

The decrease in rainfall from 5 to more than 20% accompanied by an increase in temperature will lead to a significant decrease in production, which can be estimated at more than 50% in the area between the 10th and 15th parallel north (2nd COM_Chad).

Furthermore, cotton production, which is already unstable, will experience an even greater decline due to the combined effect of higher temperatures and variable rainfall (2nd COM_Tchad).

1.2.2 Impacts of climate changes on livestock in the Lake Chad Basin

Climatic conditions determine the spatial and temporal dynamics of the vegetation cover and the sustainability of ponds, the production factors for extensive livestock farming in the Sahel area. The increase in temperatures, the intra- and interannual variability of rainfall and the decrease in the growing period led to a drastic reduction in pastures, a deficit in the pastoral and fodder balance and watering difficulties.

In the Sahel zone of Chad and Cameroon, the droughts of 1973, 1984 and 2009 resulted in the death of livestock and the widespread departure of pastoralists to more favorable areas. Moreover, the droughts led to the degradation, and in some cases disappearance, of perennial wood species in favor of annual species and invasive species. In 2009, in Chad, fodder deficits resulting from the late start of the rainy season led to an average cattle mortality rate of up to 30% (2nd COM-Chad). In Niger, the drought periods of 1968-1973 and 1977-1985 caused enormous losses of herds, which were decimated by more than 50%. At the macroeconomic level, the livestock sub-sector, which accounts for a large share of exports, could no longer make a significant contribution to the gross domestic product and trade balance (NAPA-Niger and 2nd COM-Niger) as in the past.

The future of this activity seems unsure given the looming unfavorable weather conditions. Rainfall deficits will lead to both a decrease in fodder production and a lack of water for livestock watering, severely affecting the production of mainly extensive pastoral communities. In the Sahel region, these conditions will lead to a decline in plant productivity; people and animals will tend to migrate to the wetter and therefore more productive Sudanese zone, thus exacerbating conflicts between farmers and herders. These arrivals will increase the pressure on resources and accelerate the degradation process. The risk implied with livestock (if people do not migrate) could lead livestock farmers to switch to other types of activities that could lead to changes in habits and customs as well as conflicts related to access to resource exploitation.

1.2.3 Impacts of climate changes on the fishery and aquaculture sector in the Lake Chad Basin

The fishery and aquaculture subsector is particularly vulnerable to climatic hazards. These include rising temperatures, floods and/or droughts. Droughts and rising temperatures cause water bodies, ponds or reservoirs to dry up while floods destroy the fishery infrastructure.

Recurrent droughts have affected the basin since 1973. This has led to sand encroachment, drying up and silting of water bodies and rivers, the proliferation of invasive aquatic plants, early drying or reduction in the diversity of fish fauna, water pollution, reduced fish production and degradation of water habitats. The droughts and the resulting silting shrink the hydrographic network and may have caused the loss of about 210,000 hectares of spawning grounds (2nd COM-Chad) in the floodplains of Chad and the swamps of the Chadian part of the lake. In addition, the drop in water levels in the two rivers of the basin (Chari and Logone) has affected the quality and quantity of fish production. This decline will increase if the current trend continues (2nd COM-CAR).

Furthermore, for 40 years, Lake Chad has been reduced to the mere presence of water in the southern basin and in the swamps, the northern basin of Lake Chad has long remained dry (1976-1998). These variations did not favor fish reproduction. The many and varied species commonly fished in the past can barely survive because of overfishing and falling water levels due to climatic hazards. This has had negative effects not only on aquatic ecosystems, but also on fishing communities who suffer post-catch losses, leading to their impoverishment and food insecurity. Fisherfolk were then forced to migrate or diversify their activities by switching

to agriculture, due to the uncertainty and precariousness imposed by the variability in the water level of the lake.

1.3 Adaptive capacities to the adverse effects of climate change in the Lake Chad Basin

1.3.1 Situation of the populations in the Lake Chad Basin

In the Lake Chad Basin, the incidence of poverty is relatively high: in Chad, 46.7% of the population lives in poverty; 11.0% in N'Djamena, 28.8% in other urban centers and 52.5% in rural areas⁴.

In Niger, the incidence of poverty is estimated at 48.2%. The Diffa and Zinder regions have an incidence of poverty below the national level (34% and 47.7% respectively)⁵.

In Nigeria, the North-East and the North-West are the poorest regions of the federation with an incidence of about 52%, considering the food criteria of the definition⁶.

In Cameroon, 36.1% of the population is poor, this is less than in Niger and Chad. However, the Cameroonian regions of the basin have a poverty rate of more than 50% (Adamaoua 55.1%, North 70.7% and the Far North 76.3%).

In Central Africa, the ECVR⁷ and ECVU⁸ surveys revealed that about 73.2% of rural households live below the poverty line, compared to 68.3% of urban households. The regions of Kagas and Yadé are the most affected; eight out of ten rural households are affected by poverty.

This poverty situation in the basin increases vulnerability to climate change and reduces the adaptive capacity of the population. Without intervention, the access to innovation in agriculture, access to irrigation, conversion or diversification of agricultural practices, the sustainable management of natural resources will remain difficult.

⁴ INSEED. (2013). *Troisième Enquête sur la Consommation et le Secteur Informel au Tchad (ECOSIT3)*. N'Djamena, Tchad: Institut National de la Statistique, des Études Économiques et Démographiques (INSEED).

⁵ INS & Banque Mondiale. (2013). *Profil et Déterminants de la Pauvreté au Niger en 2011 - premiers résultats de l'enquête nationale sur les conditions de vie : des ménages et l'agriculture au Niger (ECVMA)*. Niamey, Niger: Institut National de la Statistique (INS) et la Banque mondiale.

⁶ NBS. (2012). *Poverty Profile For Nigeria*. National Bureau of Statistics (NBS), Federal Republic of Nigeria.

⁷ Gouvernement de la République Centrafricaine, & PNUD. (2006a). *Profil de Pauvreté en Milieu Rural (Enquête sur les Conditions de Vie en milieu rural – ECVR - 2003)*. Bangui, RCA: Gouvernement de la République Centrafricaine et Programme des Nations unies pour le développement (PNUD).

⁸ Gouvernement de la République Centrafricaine, & PNUD. (2006b). *Profil de Pauvreté en Milieu Urbain (Enquête sur les Conditions de Vie en milieu urbain – ECVU - 2003)*. Bangui, RCA: Gouvernement de la République Centrafricaine et Programme des Nations unies pour le développement (PNUD).

1.3.2 The importance of the rural sector for GDP and employment

The rural sector is one of the key sectors for the economy of the basin countries. Its contribution to GDP varies between 20 and 57% depending on the country. It employs more than 50% of the working population⁹¹⁰¹¹¹².

Agriculture and livestock contributed on average 40% to Chad's GDP in 2001 and 25% between 2005 and 2011¹³¹⁴. In Niger, agro-silvo-pastoral production represented 41% of total GDP in 2001, compared to only 34% in 1990¹⁵.

According to the National Institute of Statistics (INS) of Cameroon, within the primary sector (19 to 21%), the production of food crops creates the major part of wealth (62.8% in 2009), followed by forestry and logging (12.8%) and livestock and hunting (12.4%), before industrial and export agriculture (6.5%) and fisheries and aquaculture (5.5%). This sector still represents nearly 40% of the GDP of Nigeria¹⁶ and 56.9% of the GDP of the CAR.

At the basin level, the rural sector is the main source of income, regardless of the region. Thus, the proportion of households living from activities in this sector exceeds 55%¹⁷¹⁸¹⁹²⁰.

About 80% of Central African households say they have agricultural land and 42% own livestock or farm animals. In Chad, 72.3 to 97.0% of households live from agriculture (Guéra 98%, Salamat, Mayo-Mayo Kebbi, 97%) in the Sudanese and Sudano-Sahelian zone which is considered as the country's agricultural region. In the Sahel and Sahelo-Saharan zone which is considered as a livestock region, 27.7 to 60.5% of households (Kanem 48%, Lake 43% and Bahr El Gazal, 46%) practice animal husbandry and only 7.2 to 18.1% of households practice arable farming²¹²²²³.

In north-eastern and in north-western Nigeria, between 28% and 55.2% of working women and more than 55% of men derive most of their income from agriculture.

⁹ INSEED. (2013).

¹⁰ Gouvernement de la République Centrafricaine, & PNUD. (2006a).

¹¹ Gouvernement de la République du Niger. (2003). *Stratégie du développement rural - Le secteur rural, principal moteur de la croissance économique*. Niamey, Niger: Gouvernement de la République du Niger.

¹² Government of the Federal Republic of Nigeria. (2010). *National Agriculture and Food Security Strategy (NAFSS) (2010-2020)*. Federal Ministry of Agriculture and Rural Development, Federal Republic of Nigeria.

¹³ INSEED, 2013

¹⁴ Gouvernement de la République du Tchad. (2016). *Plan national d'investissement du secteur rural du Tchad (PNISR) 2016-2022*. N'Djamena, Tchad: Gouvernement de la République du Tchad.

¹⁵ Gouvernement de la République du Niger, 2003

¹⁶ Government of the Federal Republic of Nigeria, 2010

¹⁷ INSEED, 2013

¹⁸ Gouvernement de la République Centrafricaine & PNUD, 2006a

¹⁹ Gouvernement de la République du Niger, 2003

²⁰ Government of the Federal Republic of Nigeria, 2010

²¹ Enquête Nationale sur la Sécurité Alimentaire des ménages ruraux (ENSA), Chad, WFM, FAO, 2013

²² Enquête Nationale sur la Sécurité Alimentaire des ménages ruraux (ENSA), Chad, WFP, FAO, UNICEF, INSEED, RT, 2014,

²³ PAM. (2005). Tchad: Analyse et cartographie de la vulnérabilité structurelle à l'insécurité alimentaire en milieu rural au Tchad. N'Djamena, Tchad: Programme Alimentaire Mondial (PAM).

In the Cameroonian part of the basin, between 84.4 and 86.5% of households are engaged in agricultural activities²⁴. Also, more than two thirds of the households are engaged in livestock farming or both (Far North, 65.9%; North 62.1% and Adamaoua 42.8%).

In the Nigerien part, 79.7% of households are occupied by these two activities; the proportions of households whose main activity is agriculture and exclusive livestock farming represent 11.3% and 11%, respectively. In the Diffa region, 77.7% of households derive their income from agriculture and livestock, while 15.7% earn an income exclusively from livestock and 6.5% exclusively from agriculture. In the Zinder region, on the other hand, 83.9% of households practice both agriculture and livestock; 17.1% live solely on livestock and 7.3% on agriculture²⁵.

1.3.3 Weak support to the rural sector

The main tasks of the services in charge of rural activities consist of the dissemination of agricultural techniques, training of agricultural producers, seed extension, agricultural statistics, epidemiological surveillance of animal diseases, vaccination and animal care and the control of slaughters and fisheries. These missions are not fully fulfilled for several reasons:

- Staff reductions in the public administration and cuts in government spending due to structural adjustment programs have significantly affected rural interventions: decrease of the number extension workers and decrease of agricultural and pastoral subsidies. Some services previously provided by the State are now outsourced to private operators who must comply with specific specifications (phytosanitary treatments, quality control). In Niger and Chad, the privatization of veterinary services has been undertaken in the livestock sector (RIBIER V., 2002). However, Cameroon's cotton zone has not been too affected by this policy. SODECOTON is considered as a "development society" because it deals not only with cotton crops, but also with food crops, livestock, land issues and environmental protection. The wave of privatization as part of the implementation of the structural adjustment programs had virtually no impact on the way SODECOTON operates. But in recent years, its area of intervention in the basin has shrunk.
- At present, agro-silvo-pastoral production suffers from weak support: insufficient organization of the producers, lack of technical supervision (insufficient qualified personnel) and the persistence of certain infectious and parasitic diseases (animal health), the absence of a research program, etc. In addition, there is a lack of knowledge of transhumant livestock farming (livestock numbers and movements).

According to the Maputo Declaration of the 12th of July 2003, the budget of ministries involved in agriculture in the broad sense should reach 10% of national budgets. In countries that could be described as "exemplary students", like Niger (2003 and 2007), the budgets allocated to the agricultural sector have approached or exceeded the symbolic 10% mark. Today at the basin level, the highest proportion of the budget allocated to this sector is 5.26% (Finance Acts 2012, CAR) (Table 2).

²⁴ INS. (2006). *Troisième enquête camerounaise auprès des ménages (ECAM III)*. Yaoundé, Cameroun: Institut National de la Statistique (INS).

²⁵ Gouvernement de la République du Niger. (2007). *Volet Agriculture. In Recensement général de l'agriculture et du cheptel (RGAC 2005/2007) - Volume III Résultats Définitifs* (pp. 1–112). Niamey, Niger: Gouvernement de la République du Niger, l'Union Européenne et l'Organisation des Nations unies pour l'alimentation et l'agriculture (FAO).

Table 2: Share of agricultural budget in the broad sense in the Lake Chad Basin

Country	Total budget	Budget of the agricultural sector	Proportion / %	Ministries in charge of
Cameroon	4,234,700,000,000 CFA francs	167,740,266,000 CFA francs	3.96	Rural sector
CAR (2012)	441,300,000 EUR	23,200,000 EUR	5.26	Rural sector
Chad	1,296,000,000,000 CFA francs	?	?	
Niger	1,786,128,517,216 CFA francs	76,089,074,833? CFA francs	4.26	Agriculture, livestock and fisheries
Nigeria	6,077,680,000,000 NGN	76,753,672,275 NGN	1.26	Agriculture

Source: Finance Acts of the countries, 2016

According to UNDP (2012), more than 70% of villages in Chad do not have adequate extension workers coverage. The technical capacity of the management services is weak, and the technical monitoring of small producers is insufficient.

In Niger, on the other hand, the services in charge of the rural sector are supported in their missions by a network of producer organizations (POs). The activities covered by this network concern all aspects of rural development, particularly the improvement of production conditions, economic and social promotion and the management of natural resources. A total of 595 POs for agricultural development and 4 POs for livestock were identified in 2006 in the Diffa region compared to 674 POs for agriculture and 25 POs for livestock in the Zinder region (RGAC, 2005/2007).

In CAR, in addition to the lack of supervision and of the necessary skills, there is a lack of a dynamic organization to defend the interests of the rural population, such as rural organizations (GIR), which have almost disappeared throughout the country (NGAWEN, J., 2009).

1.3.4 Agricultural production systems

Sahelian systems: The Sahel Zone and the Sudano-Sahel Zone constitute the largest agro-ecological area in the conventional basin. They cover 43% of the territory of Chad, the Far North Region of Cameroon, the Nigerian part of the non-Sudanese basin, south-east Niger and the prefecture of Vakaga in the CAR. The main crops are peanuts, cowpeas, cereals, especially pearl millet, sorghum, wheat and maize, with or without water control, grown on the polders of the Lake. Rice is also cultivated with or without water control, as well as flood-recession sorghum, market gardening, and fruit crops.

- *Extensive and semi-intensive rainfed agropastoral systems:* They are found in the cotton area and its northern borders (Cameroon), the dune systems (Chad), the southern part of the Zinder region and the south-western plains of the Diffa region. Most of these rainfed production systems are depending on rainfall, with results, among others, in seasonal variations in crop production, resulting in permanent food insecurity. This system can evolve towards better fertility management, through intensification/diversification of the cropping system, introducing more vegetable crops (cowpeas), the development of larger livestock and agroforestry.

- *Irrigated agriculture:* These are the oasis systems, the rice-growing areas (Chad), the river systems of Komadougou and of the Lake Chad, the basins of the Maïné Soroa region (Niger) and the Maga-Yagoua rice-growing area (Cameroon). The constraints of the oasis systems and the basins of Maïné Soroa are the risk of silting up and their isolation, which makes it difficult for products to access markets. Their main advantage lies in the diversification of production (cereals, vegetables, fruit and fodder, which allows a good combination of agriculture and livestock and the use of draught animals for water drainage) and in the fact that they are little affected by rainfall hazards.
- *Mixed systems:* These are the polder systems of the lake and include wheat and maize cultivation with or without water control, combined with sedentary livestock farming. The main problem is the salinization of the soil.
- *Flood-recession crops:* They are practiced in the floodplains of the Logone and Chari rivers, in the Salamat Region in Chad, the Far North and the Balgué in Cameroon and the shores of the lake. They are mainly characterized by flood-recession sorghum and a diversified production of cowpeas, maize and vegetables in the vicinity of the lakes. The main problems are low rainfall and the lack of flooding.

Sudanese zone systems: These systems extend over southern Chad (about 10% of the territory), in the North-East and Bamingui Bangoran regions (Central African Republic), in the Mayo-Rey department (Cameroon), in northern Adamawa and southern Bauchi, Kano and Jigawa (Nigeria). The average annual rainfall varies between 750 mm and 1200 mm. In the Sudanese zone, agriculture suffers the least from the vagaries of the climate and requires few adaptation measures. Soils are relatively more fertile and available due to the small size of the local livestock and population density (except in Nigeria). The main agricultural activities are cotton production, cereal farming and sedentary livestock production, root and tuber production, especially cassava; market gardening and orchards are developed around the main cities (Dutse, Moundou, Bauchi, Sarh) and monoculture rice without water control in the river area (Chad). In this system, the use of animal traction (cattle and donkeys) is quite widespread as well as the use of fertilizers. The agriculture-livestock association is well underway, and cattle and sheep fattening is widespread.

Production systems in the Guinean area: they are practiced in the southern part of the basin and include the Bozoum, Bocaranga and Kaga Bandoro regions in the Central African Republic and the Mbéré and Vina sub-basins in Adamaoua (Cameroon). Rainfall is over 1200 mm and the soil is relatively more fertile and deeper; agriculture is currently subject to little or no climatic constraints. This agro-ecological zone is the domain of the production of roots and tubers (yam, cassava, taro, potato) and maize. The low population density and the rarity of tsé-tsé flies due to the altitude have allowed the development of cattle breeding.

1.3.5 Irrigated agriculture in the Lake Chad basin

The River Basin Development Authorities (Hadejia Jama'are River Basin Authority), Kano Irrigation Development Project (KIDP), the South Chad Irrigation Project (SCIP) and the Baga Polder Project were the most ambitious agricultural projects in Nigeria. Their objectives were to lessen the impacts of climatic hazards on agriculture. A dozen dams were built until 1986. The developments on the Jamaré River have enabled the development of irrigated agriculture whose production supplies the Nigerian markets with spices and vegetables. The other projects in the basin did not achieve their objectives, but on the ruins of the South Chad Irrigation Project (SCIP) and the Baga Polder Project, in the Koumadougou Yobe Valley, market gardening activities have developed over a distance of about twenty kilometers, where

farmers give a second life to the project's infrastructure, which are regaining importance, with entirely different functions from those originally planned (Igué J, 2006; Géraud Magrin, 2013).

In Cameroon, apart from the developments of the SEMRY-I and SEMRY-II and possibly SEMRY-III projects, off-season agriculture is practiced only in small irrigated schemes developed on the banks of the Mayo Raneu, along the Mayo Tsanaga and its affluents (Mayo Kaliao and Mayo Ziling), in the valley of the Mayo Ngassawe, of the Mayo Motorsolo (Seignobos C. and Lyébi-Mandjek O., 2000), and of the Logone, the Chari and the Serbewel rivers. This essentially market-gardening-based agriculture employs producers who use unsustainable techniques and do not benefit from guidance and substantial financial support. Onions, the main crop, are the second most important cash crop after cotton.

Among the constraints, the inadequacy of the control of irrigation techniques can be mentioned. Poor storage conditions also affect the quality of onions. Moreover, information on new techniques and new cultivars is not disseminated. This leads to poorly controlled fertilization and phytosanitary protection and to the use of seeds that are produced without quality guarantees. This may explain the low level of yields, on average 6 tonnes/ha in 2001, while in some countries, where producers are better organized, onion yields approach 20 tonnes/ha on average (Cathala, M, 2007).

Various hydro-agricultural developments are being carried out in Chad. These are the developments of large industrial areas (such as the total water control developments for rice cultivation and the partial water control developments of SODELAC, the schemes A, B, C of Bongor, the sugar perimeter of Banda, the developments of village market gardening schemes and the development of wadis and oases (GIZ, 2015). Technical and financial constraints limit the extension or the redevelopment of these small, essentially market gardening schemes. Significant efforts have been made in recent years to control water through the construction of hydro-agricultural facilities, both public and private. However, very few areas are irrigated. The costs of developing small-scale irrigation and water retention and pumping costs (fuel prices) remain very high in relation to revenues of small producers, while the budget allocated to the sub-sector is insufficient. Indeed, a significant part of the funds is intended for the development of large areas less used by small producers, which are not adapted in terms of local ownership in the long term. In addition, poor small producers do not have access to credit (UNDP, 2013).

In Niger, the area of market gardening crops is estimated at 73,345 ha, of 25.5% are irrigated. In the Zinder region, 42% of the area is cultivated with market gardening crops by 158,715 producers. In the Diffa region, 14.6% of the area is used for market gardening by 21,446 producers. The area cultivated with selected seeds represents 11% of the market gardening area cultivated in non-flood-recession areas, while this proportion is only 0.1% in flood-recession market gardening. The combination of organic fertilizers with chemical fertilizers is the most common fertilization practice used by market gardening producers in areas where flood recession farming is not practiced. This practice is applied on 53% of the cultivated area. Chemical fertilizers alone and organic fertilizers alone are used on 31% and 12% of the cultivated area, respectively.

1.3.6 Limited access to inputs and innovation

In the Lake Chad Basin, producers have little access to agricultural inputs. The level of access to inputs is at highest in the Nigerian part of the basin. According to the survey conducted by the National Bureau of Statistics (NBS) in 2012, 42.5% and 77.1% of producers fertilize their farms with chemical and organic manure respectively in the North-East and the North-West; 14.8% and 25% use pesticides. Up to 33.5% and 42% producers respectively in the North-East and in the North-West sow improved and climate-adapted varieties (NBS 2012).

In northern Cameroon, organic fertilizer is the most widely used fertilizer; about 41% of farmers use it and 17% use chemical fertilizers. The work of the Institute of Agricultural Research for Development (IRAD) and its partners through the SAFGRAD, NCRE and Garoua projects has made it possible to develop and disseminate, among other things, improved varieties of sorghum and maize (S35, CS 54, Zouaye, CMS 8501, CMS 8704, CMS 9015, CMS 8806), with a short- to medium-length growing cycle, which are relatively productive (2 to 5 tonnes/ha), drought-resilient, resistant to *Striga hermonthica* and with good nutritional characteristics. It seems difficult to continue the maintenance of pre-basic seeds and the production of basic seeds to supply multipliers and producers because the seed networks are financed by programs/projects which run for a specific period.

In Chad, according to UNDP (2012), the quantity of seeds made available to producers is insignificant compared to their needs; it therefore cannot cover national needs. In 2008 and 2009, less than 20% of the cattle population was vaccinated against animal diseases, compared to 60% in the past. Investigations have shown that the causes of underperformance lie in the failure of the National Animal Disease Epidemio-Surveillance Network in Chad (REPIMAT) and the insufficient capacity of veterinary services in the field. A project on the improvement of the seed sector is currently being implemented, with funding from Swiss cooperation. In the medium term, this project will enable to structure this environment and strengthen local capacities to ensure the sustainability of the availability of improved seeds.

In the Central African Republic, the seeds and their treatment technique are still traditional. Despite the existence of an agricultural research institute in the country, the quality of the seeds has not yet improved. The main inputs used are fertilizers, and particularly manure. A study carried out in 2001 by IFAD on data linked to the use of fertilizers data for the countries in the subregion revealed that Central African farmers have very limited access to fertilizers compared to other farmers in the subregion. This can partly be explained by the fact that the fertilizer use stands at only 0.6 kg per hectare in CAR. With regard to livestock production, the main inputs used by Fulani pastoralists for their livestock are mainly natron, salt and—to a much lesser extent—some veterinary products. These types of inputs used are largely deprived of the nutrients which not only promote the growth of livestock, but also improve the quality of meat (Djamawa Endjikpeno, 2009).

Niger's seed sector suffers from reduced seed production capacities. Following the Government's request regarding seed requirements during the 2005 food crisis, in 2006, the FAO launched a program to produce quality seeds of improved varieties of millet, sorghum, cowpeas and peanut with a financial contribution from Belgium and (beginning in 2009) from the European Union. This support has helped to create conditions for the rehabilitation of the seed sector in five agricultural regions of Niger, including Zinder and Diffa. The mass mechanization of the 1970/1980 period has faded away; the State tends to reduce subsidies while credit opportunities are increasingly limited. In addition to this unfavorable economic situation, there are the usual constraints imposed by the cost of equipment, a lack of adequate training, technical deficiencies, but also by the operating structures and the association of

crops that are not well-adapted for the introduction of animal traction. On the other hand, animal traction can contribute to the reinforcement of wind and water erosion.

The most common feeding method for cattle is a combination of trough feeding and grazing (64.2%). Grazing is the second most common feeding method for cattle, with 25.1% of households practicing it, followed by trough only with 10.6%. Nomadism is practiced by 29% of Zinder livestock producers; 13.6% of the Zinder livestock producers and 12.1% of the Diffa livestock producers are transhumant. Vaccination coverage is relatively low: 50% of sheep and goats were vaccinated in the Diffa region and 80% in Zinder; 22% and 63% of cattle were vaccinated in Diffa and Zinder respectively (Republic of Niger, EU and FAO, 2007).

1.3.7 Traditional adaptation techniques

In the Sudanese zone of Chad, agriculture with animal traction was introduced in the 1960s, but has not yet reached all farms. To date, despite the provision of tractors for mechanized cultivation by the National Food Security Programme (PNISA), the equipment rate of agricultural producers in the Sudanese zone is only slightly above 31%²⁶. In the sector of animal production, there has been a significant decrease in animal disease surveillance and treatment activities compared to what was achieved 10 years ago (UNDP, 2012).

According to the National Bureau of Statistics (NBS) (2012), 58.4% and 50.6% of farmers use animal or mechanical traction in plowing and other crop maintenance operations in the north-eastern and the north-western regions in Nigeria, respectively. Only 25% of farmers in Cameroon and 10% in Central Africa are equipped with animal traction. According to Vall et al. (2003), animal traction is used for plowing, secondarily for maintenance and transport operations. It helps to control weeds, acts on water management on the plot, and contributes to the maintenance of fertility through fertilization. It also increases the area cultivated per farm and diversifies their income. Other techniques for adapting to the variability of rainfall in farms include techniques for improving agricultural production (market gardening, irrigated crops and off-season cultivation, water-spreading weirs), stock management techniques and diversification of income sources through small-scale livestock, small-scale trade and fishing (GIZ/LCBC, 2015).

Bazin, F et al (2013) identified two categories of strategies: low hazard adaptation and exceptional hazard adaptation. For low hazards, transhumance makes it possible to respond to seasonal variations in the quantity and quality of resources. In the event of exceptional hazards, mobility is also exceptional, herders migrate from the Saharan areas to the Sahel, then from the Sahel to the Sudanese area. The size of the herd is also a determining factor in the ability of a farmer to support his family (milk production, income to buy cereals...). In the event of a crisis, farmers therefore seek to ensure the survival of a minimum number of animals, particularly of young female breeders, by selling a part of their herd, which helps both to reduce pressure on natural resources and to give them the means to buy food supplements.

Peri-urban systems, mixed systems (agro-pastoralists or pastoralists who also cultivate crops; or farmers who breed cattle) and semi-intensive systems seem to be resilient to climatic hazards.

²⁶ During the last operation of the ONDR, 10,000 ploughs were ordered and sold with a subsidy of nearly 65% of the purchase price. These operations have ruined local manufacturers.



Source: GIZ

Photo: Water-spreading weir

2 SECOND PART: ANALYSIS OF CLIMATE CHANGE ADAPTATION POLICIES

2.1 National climate change adaptation policies

To mitigate the impacts of climate change on populations and in a perspective of sustainable development, LCBC member countries have analyzed and assessed the vulnerability of different sectors and their adaptation needs. Diagnostics have enabled them to develop their own National Adaptation Programs of Action (NAPA) or National Adaptation Plans (NAP).

These various programs and plans have taken into account the vital sectors of the economy of the countries, the objectives and the priorities identified in the documents of the National Poverty Reduction Strategies of these countries.

2.2 Vulnerability of the subsectors to climate change and adaptation needs

2.2.1 Vulnerability and adaptation needs in the Cameroonian part of the basin

Vulnerability

The adverse impacts of climate change recorded in the Cameroonian part of the basin are mainly the decrease of the agro-pastoral and fishery productivity, the disappearance of some cultivated varieties, and the disturbance of the agricultural calendar (see Table 3).

Table 3: Impacts of climate change in Cameroon

Subsector	Vulnerabilities
Agriculture	<ul style="list-style-type: none"> • Disappearance of some cultivated varieties • Inter-community conflicts related to land issues • Disruption of the agricultural calendar • Decrease in agricultural productivity and production or decrease in yields due to: <ul style="list-style-type: none"> ○ Shortening of the vegetative cycle; ○ Increased crop loss rate ○ Drying up and destruction of crops ○ Decrease in the groundwater table ○ Reduction of soil moisture or soil leaching and low germination ○ Loss of livelihoods and impoverishment.
Livestock	<ul style="list-style-type: none"> • Decreased yields and productivity of the livestock • Decrease in pastures, forage deficit and modification of transhumance circuits; • Anarchic occupation of protected areas • High mortality and morbidity of livestock • Increase of livestock in mountain areas • Disruption of the agricultural calendar • Reduction of water quantity for livestock
Fishery	<ul style="list-style-type: none"> • Strong decrease in fish stock • A lot of fisherfolk move into agriculture and livestock • Disappearance or predominance of certain fish species • Loss of habitat for sensitive fish species • Change in species composition • Decrease in fish productivity • Drying up of lakes and ponds or reservoirs • Destruction of fry

Sources: PNACC and ²⁷

Adaptation needs

In addition to the cross-cutting need for early warning, several adaptation were formulated in different sub-sectors including the fight against sand encroachment and silting of rivers, the large-scale promotion of agricultural practices for soil and water conservation (SWC), agricultural diversification, the promotion of intensive livestock farming, the development of actions to reduce vulnerability and fish farming in ponds.

²⁷ PNUD. (2012). *Evaluation des risques, de la vulnérabilité et adaptations aux changements climatiques*. Yaoundé, Cameroun: Programme des Nations unies pour le développement (PNUD).

Since that women are major stakeholders in society in Cameroon, the gender dimension was recommended in the implementation of climate change adaptation measures in the Cameroonian NAP. Thus, they have been given special attention in the formulated projects and/or programs.

Despite their fragility, forest ecosystems in the Sudano-Sahelian zone are not considered a priority for CC adaptation actions. It is the humid forests that have been retained despite their high resilience capacity and low exposure to hazards (droughts, bush fires) (see Table 4).

Table 4: Recommendations for climate change adaptation in Cameroon

Subsector	Adaptation options
Livestock	<ul style="list-style-type: none"> • Rehabilitation of breeding centers to ensure the monitoring of climate data and monitoring-evaluation of the fodder availability in pastoral areas; • Development of pastoral hydraulics; • Promotion of intensive livestock; • Integration of climate changes in the pastoral code
Fishery	<ul style="list-style-type: none"> • Strengthening fisheries exploitation systems and disseminating information on climate change • Establishment of a fisheries management system for dams and other water reservoirs • Implementation of a protocol for monitoring/evaluation of fish populations • Creation and promotion of fish ponds • Creation and promotion of sustainable fish farming techniques.
Agriculture	<ul style="list-style-type: none"> • Implementation of agro-climatological research projects and dissemination of adapted sustainable agricultural practices; • Promotion of sustainable soil and water conservation and soil protection and rehabilitation (SWC/SPR) techniques • Agricultural diversification.

Sources: PNACC and ²⁸

²⁸ PNUD, 2012

2.2.2 Vulnerability and adaptation needs in the Nigerien part of the basin

Vulnerability

Drought remains one of the most frequent extreme phenomena in Niger. The main adverse impacts of climate hazards on the rural sector are declining production and degradation of natural resources (Table 5). The third communication presents two opposing scenarios²⁹:

- A dry scenario that predicts, between 2011 and 2050, rainfall deficits resulting in: reduced crop yield and loss of production; erosion of productive land and silting of rivers; damage to agricultural infrastructure, reduction in the length of the agricultural season and the appearance of crop pests
- A wet scenario between 2011 and 2050, characterized by years of annual rainfall in excess in comparison with the 1961-1990 period. The potential impacts are: abundant rainfall with many potential positive effects that can contribute to improved agricultural production; increased frequency of flooding of crop areas; asphyxiation and reduced plant development due to a water excess; appearance of diseases and some crop pests linked to water excess conditions; and reduction and/or total loss of agricultural production and sometimes even human lives in flood-affected areas.

Table 5: Impacts of climate changes in Niger

Subsector	Vulnerabilities
Agriculture	<ul style="list-style-type: none"> • Decrease in agricultural production; • Increase of pests such as desert locusts, grasshoppers, earworm caterpillars, etc.); • Reduced yields and loss of crop production; • Increased food insecurity and malnutrition; • Increased imports and food aid; • Erosion of productive land and silting of watercourses; • Damage to agricultural infrastructure; • Increased frequency of flooding of crop areas (wet scenario); • Asphyxia and reduced plant development due to excess water (wet scenario).
Livestock	<ul style="list-style-type: none"> • Fodder deficit; • Lack of water points; • Lack of rainfall leading to lower productivity; • Migration of humans and animals to move to more productive areas; • Conflicts between farmers and herders; and • Upward trend in forage resources (wet scenario).
Fishery	<ul style="list-style-type: none"> • Decrease in fishery production; • Decrease in biodiversity

Source: NAPA Niger and 3rd National Communication

²⁹ 3rd COM_Niger

Adaptation needs

In addition to the measures adopted in the NAPA, the second national communication proposed alternative solutions such as promoting alternatives for non-agricultural employment in rural areas; extending irrigation; integrated land and water management; developing effective early warning systems (particularly for extreme events such as droughts and floods); as well as livestock development (village poultry, livestock and meat sector) and capacity building of technical services (Table 6).

Table 6: Adaptation options proposed by the NAPA in Niger

Subsector	Adaptation options
Agriculture	<ul style="list-style-type: none">• Creation of grain banks;• Promotion of income-generating activities (IGAs) and development of mutual assistance associations;• Production and dissemination of agro-meteorological information;• Diversification and intensification of irrigated crops;• Enhancement of the basins intended for irrigated crops• Education about plant species that are most adapted to climate change
Livestock	<ul style="list-style-type: none">• Education about animal species that are most adapted to climatic conditions;• Enhancement of livestock feeding banks;• Establishment of stores for veterinary products;• Introduction of fodder species in the pastoral environment• Promotion of peri-urban market gardening and livestock farming• Rehabilitation and rational management of transhumance corridors
Fishery	<ul style="list-style-type: none">• Shoreline protection and pond rehabilitation;• Promotion of animal and plant species best adapted to climatic conditions;• Control of silting of ponds or water points;• Control of invasive aquatic plants;• Stocking of water points (ponds, reservoirs, etc.) with fish.

Source: NAPA Niger and regional validation workshop

The vulnerability analysis conducted in preparation for the NAPA showed that people with disabilities, children and women are the most vulnerable to climate change. However, no specific recommendations are made to strengthen their resilience. Similarly, no mention is made of the strengthening of regional or sub-regional cooperation in the production and dissemination of agro-hydrometeorological information [AGRHYMET, African Centre for the Application of Meteorology for Development (ACMAD), or the Assessment of Impacts and Adaptation to Climate Change project with its West African components (AIACC)].

2.2.3 Vulnerability and adaptation needs in the Sahelo-Sudanese zone in Nigeria

Vulnerability

The main consequences of current and future climate change in the Nigerian part of the basin are the decline in agricultural and pastoral production and the degradation of natural resources (Table 7).

Table 7: Impacts of climate changes in Nigeria

Subsector	Vulnerability
Agriculture	<ul style="list-style-type: none"> • Decrease in agricultural yields • Food and nutritional insecurity • Decrease in the production of associated economic activities: processing and distribution • Inter-community conflicts • Land degradation
Livestock	<ul style="list-style-type: none"> • Decrease in pastoral productivity; • Decline of fodder production/fodder deficit • Conflicts between livestock herders and farmers • Watering issues
Fishery	<ul style="list-style-type: none"> • Reduction of dry-season habitats, essential for maintaining fish populations.

Source: NASPA-CCN and 2nd Communication

Adaptation needs

To strengthen Nigeria's resilience to climate change, recommendations were made for the implementation of policies, strategies, plans or programs on biodiversity, desertification and integrated water resource management. Climate and gender changes must be considered in the revision of sectoral policies (Table 8).

Table 8: Recommendations for climate change adaptation in Nigeria

Subsector	Adaptation options
Agriculture	<ul style="list-style-type: none"> • Implementation of strategies for an improved management of natural resources: <ol style="list-style-type: none"> 1. Promotion of sustainable irrigation systems; 2. Promotion of appropriate reforestation techniques; 3. Modernization of plant and animal production
Livestock	<ul style="list-style-type: none"> • Introduction of semi-intensive livestock farming or intensification of livestock production; • Enrichment of pastures with fast-growing herbs/shrubs; • Development of a zoning plan; • Improvement of pastoral water projects (expand rainwater harvesting practices for livestock; build more water harvesting structures, wells or boreholes)
Fishery	<ul style="list-style-type: none"> • Improvement of small-scale fishing and support for sustainable aquaculture • Use more resistant and early maturing fish species

Source: NASPA-CCN et 2nd Communication

2.2.4 Vulnerability and adaptation needs in CAR

Vulnerability

In addition to the decline in agricultural and pastoral production and the degradation of natural resources already recorded, transhumance will become necessary for pastoralists in the Sudanese zone who were once sedentary. There is a proliferation of animal and crop disease vectors in this area (Table 9).

Table 9: Impacts of climate changes in CAR

Subsector	Vulnerability
Agriculture	<ul style="list-style-type: none"> • Disruption of agricultural calendars and of the perennial crop cycle; • Decrease in production; • Development of agricultural pests; • Soil erosion.
Livestock	<ul style="list-style-type: none"> • Loss of livestock and decrease in production; • Development of waterborne diseases and vectors; • Decreasing pasture productivity; • Transhumance becomes necessary.
Fishery	<ul style="list-style-type: none"> • Silting up of rivers and impoverishment of fishing potential.

Source : NAPA CAR

Adaptation needs

Primary adaptation needs were identified in the agricultural sector. They will help to strengthen the resilience of this production sector (Table 10). It should be noted that little attention has been paid to gender and cooperation in the production and dissemination of agro-hydro-meteorological information.

Table 10: Adaptation needs in CAR

Subsector	Adaptation options
Agriculture	<ul style="list-style-type: none"> • Mitigation of the impacts of climate change on agricultural production; • Mitigation of the adverse impacts of climate change on the quality of the agricultural resources • Adaptation of the agricultural calendar to climate changes

Source: NAPA CAR

According to the Second National Communication on Climate Change, adaptation measures must be considered in spatial planning. In addition to those presented in the NAPA (Table 10), measures for lowland development and conservatory water and soil management are important for better adaptation.

2.2.5 Vulnerability and adaptation needs in Chad

Vulnerability

In addition to the decline in agro-pastoral productivity and the degradation of natural resources, the significant effects of climate change in Chad include the modification of transhumance routes and the relocation of pastoral activities from the Sahelo-Saharan zone to the Sudanese zone (Table 11).

Table 11: Impacts of climate changes in Chad

Sub-sectors	Vulnerability
Agriculture	<ul style="list-style-type: none"> • Loss of some cultivated species; • Decrease in agricultural yields; • Decline of the area suitable for cotton production.
Livestock	<ul style="list-style-type: none"> • Changes to the traditional transhumance routes; • Relocation of pastoral and agricultural activities around protected areas; • High mortality rates in the wood stratum with profound repercussions on pastoral systems; • Loss of genetic diversity • Fodder deficit and yield decline.
Fishery	<ul style="list-style-type: none"> • Conversion of many farmers and herders to a subsistence fishery; • Significant migration of northern populations and foreigners to Lake Chad, around areas with water resources; • Considerable decrease in fish stocks.

NAPA and 2nd Communication Chad

Adaptation needs

To further reduce the effects of climate change on these three sectors, the second National Communication of Chad added the following measures to the options proposed by the NAPA: redefining agro-climatic zones and reassessing their cultural potential; strengthening adaptive capacities by revising the agricultural calendar and promoting intensive agriculture and farming (fertilization, short-cycle varieties, diversification, irrigation, fodder production, etc.) (Table 12).

Table 12: Adaptation options proposed for climate change in Chad

Subsector	Adaptation options
Livestock	<ul style="list-style-type: none"> • Valuation of agro-industrial byproducts (oil press cake, bagasse, etc.) and agricultural residues for livestock feed; • Promotion of peri-urban livestock farming; • Creation and extension of fodder banks; • Revision of transhumance corridors and intercommunity grazing areas; • Valuation of endogenous knowledge and know-how in animal health.
Agriculture	<ul style="list-style-type: none"> • Intensification and diversification of agriculture; • Promotion of market gardening; • Elaboration, dissemination and sustainability of crop calendars; • Promotion of the value chain; • Establishment of an integrated structure for locusts and other climate-sensitive pest monitoring; • Realization of soil protection and restoration works for the development of agricultural activities; • Promotion and extension of new agroforestry techniques: assisted natural regeneration (ANR)
Fishery	<ul style="list-style-type: none"> • Value enhancement of fishery and aquaculture products through better processing, conservation and marketing. • Increased production on a sustainable basis. • Preservation of fish ecosystems, participatory management and biodiversity conservation. • Institutional capacity building and fish farming development.

Source: NAPA, 2nd National Communication and Schéma Directeur de Développement de la Pêche et de l'Aquaculture

The vulnerability study conducted in the run-up to the NAPA and the second communication showed that, regardless of the country's agro-ecological zone, women, children and elderly people are the most vulnerable groups to climate change. However, no gender-specific recommendations were made, although women were involved in the process of drafting this document.

2.3 Selected projects and programs

2.3.1 Selected climate change adaptation projects in the rural sector in Cameroon

A total of eight projects were formulated, seven (7) of which are concerned with climate change (three projects focusing directly on the rural sector and four cross-cutting projects). These are:

- Development of integrated and resilient agriculture to face the impacts of climate change;
- Reducing livestock vulnerability to the impacts of climate change;
- Reducing the impacts of climate change on the fishery sector;
- Reducing the vulnerability of forests to climate change in Cameroon;
- Education, vocational training and capacity building on climate change;
- Considering climate risks in updating the Land Use Plan;
- Establishment of an observation, information management and warning system on climate risks in Cameroon.

For the implementation of these programs, a budget of 34 million euros has been estimated. This budget seems insufficient to cover these national programs because some measures such as improving road access to production basins, improving access to drinking water and sanitation services, flood control, pastoral hydraulics and the construction of water retention structures require expensive civil engineering and hydraulic works. Similarly, a larger budget would be required to sustainably improve food security and promote intensive livestock farming in production basins vulnerable to climate change.

It should also be noted that Cameroon has defined the modalities for integrating climate change into the Planning, Programming, Budgeting and Monitoring (PPBS) of these projects.

2.3.2 Selected climate change adaptation projects in the rural sector in Niger

The priorities for Niger in its climate change adaptation strategy have been categorized as follows:

- Introduction of fodder species in pastoral areas;
- Promotion of livestock feeding banks;
- Rehabilitation of basins for the promotion of irrigated crops;
- Promotion of income-generating activities and development of mutual assistance associations;
- Popularization of animal and plant species best adapted to climatic conditions;
- Production and dissemination of agro-climatic information;
- Promotion of grain banks;
- Development of SWC/SPR measures for agricultural, forestry and pastoral purposes;
- Strengthening the material, technical and organizational capacities of rural producers.

Out of nine selected projects, four are financed to an amount of \$160,509,621 by the UNDP, the FAO, the GEF and the World Bank.

2.3.3 Selected climate change adaptation projects in the rural sector in Nigeria.

The following five programs were planned for the short and medium-term implementation in the rural sector in Nigeria:

- Improving weather forecasts and the early warning system;
- Establishment of agricultural extension services for climate change adaptation;
- Support to research and information/data collection;
- Increased public awareness on climate change adaptation;
- Exploitation of business opportunities by supporting adaptation to climate change (new crop varieties, aquaculture, etc.)

The particularity of the NASPA-CCN is that it recommends the immediate implementation of sectoral plans and programs that include climate change adaptation measures. It also recommends the revision of sectoral strategies to integrate adaptation measures which consider gender aspects. International and regional cooperation in this area is not left out as it was recommended that the government actively and effectively respond to global and regional initiatives on adaptation to climate change. Any action to plan or implement the NASPA-CCN should be reviewed and attach importance to the existence of opportunities for sub-regional collaboration on climate change response strategies, in particular with the AGRHYMET center (climate modeling, scenario development and meteorological data), the coordination of policies and actions on climate change in ECOWAS member countries and cooperation on regional climate change projects.

2.3.4 Selected climate change adaptation projects in the rural sector in CAR

Based on a Multicriteria Analysis (MCA1), the team for the development of the NAPA team 12 of the 30 options initially proposed. With a second MCA (MCA2), the selected options were classified as the six "highest priority" options. Then a third MCA (MCA3) brought out 10 projects that became the subject of profiles annexed to the NAPA document. Of the 10 projects selected, there is one on forestry and one on agriculture and two cross-cutting projects involve the Central African part of the basin. The projects are about:

- Development of climate-resilient varieties in the central and northern regions of CAR;
- Capacity building of local communities on the risks of sudden climate change;
- Establishment of an early warning system and prevention/mitigation of the adverse impacts of climate change in local communities in CAR.

These three projects have a projected budget of \$1,250,000. It should be noted that this amount does not seem to cover the defined actions. As an illustration, the project "Development of climate-resilient varieties in the central and northern regions of CAR" received \$45,195,000 funds³⁰ from UNDP. This amount is 36 times higher than the costs anticipated when the NAPA was prepared.

³⁰ UNFCCC. (2019). Status of NAPA implementation under the LDCF. Retrieved April 1, 2019, from <https://unfccc.int/fr/node/733>

2.3.5 Selected climate change adaptation projects in the rural sector in Chad.

In Chad, ten of the 28 options identified and preselected were selected according to the prioritization criteria and divided into nine projects related to climate change, six of which focus on the rural sector and three focus on cross-cutting aspects for a total of 6,100,000,000 CFA francs. The projects are on:

- Mobilization of surface water for agriculture and livestock feeding;
- Crop diversification and intensification in the Sudanese and Sahelian zones;
- Improvement and dissemination of crop calendars;
- Construction of soil protection and conservation works for agricultural development;
- Improving intercommunity pastures;
- Improving information, education and communication on climate change adaptation;
- Improving the quality of seasonal precipitation and surface water flow forecasting and its integration into the vulnerability monitoring strategy;
- National Observatory on Climate Change Adaptation Policies;
- Livestock fodder bank.

The implementation of activities programmed in these agricultural and pastoral projects of national scope or covering more than one agro-ecological zone would require a larger budget than foreseen. The mobilization of surface water for agriculture and livestock through civil engineering works, crop diversification and intensification, the construction of soil protection and conservation works for the development of agricultural activities and the establishment of a livestock feed bank are costly operations.

The project "Mobilization of surface water for agriculture and livestock feeding" has been approved for funding under The Least Developed Countries Fund (LDCF), an initiative of the GEF, to the amount of \$28 million. As of September 22, 2015, \$13 million funds have been provided by this initiative for the implementation of the NAPA³¹. Four projects, including agricultural diversification, soil restoration, pastoral care and capacity building, which will be launched next year, are being funded by the European Union through the Global Climate Change Alliance for €8 million³². To date, these projects have been fully implemented.

³¹ UNFCCC, 2019

³² AMCC. (2019). *Fiche Synoptique des Projets d'Adaptation*. Alliance Mondiale Contre le Changement Climatique (AMCC). Retrieved from <https://amcc.tchadenvironnement.org/projets-pilotes-dadaptation/fiche-synoptique-des-projets>

2.4 Regional initiatives for climate change adaptation

There is no regional climate change adaptation strategy at the LCBC. The SAP, which defines the commission's activities, does not explicitly address this issue. However, climate change adaptation and mitigation aspects are addressed under the fourth and the fifth Ecosystem Quality and Water Resource Objectives (EQWROs) ("restoration, conservation and sustainable use of bioresources in the Lake Chad Basin" and "restoration and preservation of ecosystems in the Lake Chad Basin") through the promotion of environmentally sound agricultural practices, the development of transhumance areas, combating desertification and deforestation, and land conservation and restoration. However, other LCBC strategic documents clearly address the issue without focusing on it.

2.4.1 Lake Chad Basin Sustainable Development Program (PRODEBALT)

In PRODEBALT, a whole component has been devoted to adaptation to climate change, the objective of which is to increase the adaptation of socio-economic activities to climate change and to develop production systems in a sustainable way. It is structured around:

- Integrated Water Resources Management (IWRM);
- Sustainable management of forest resources;
- Forest regeneration and the promotion of alternative sources to wood energy;
- The promotion of agroforestry with fruit species and silvo-pastoral products that improve soil fertility;
- The rational development and management of fisheries resources and the alternative initiative of sustainable local development through microprojects focusing on income-generating activities;
- The exploitation of wetlands in the immediate vicinity of the Lake in accordance with by-women-management plans.
- Master Plan for the Control of Sand and Water Erosion in the Lake Chad Basin (SDLEEH)

The priority actions selected in the SDLEEH are in line with the requirements of climate change adaptation and/or mitigation. Actions to control water erosion such as controlling run-off water, controlling water erosion or increasing population resilience to hazards and rainfall variability are excellent applications for climate change adaptation. These actions are mainly derived from conservation agriculture and SWC/SPR techniques, integrated watershed and waterway management³³. The Master Plan also included mechanical and biological actions to combat siltation³⁴. These activities contribute to sustainable land management, improve rainfed agricultural productivity, restore degraded pastoral areas, contribute to the protection of vulnerable ecosystems and provide anti-erosion measures.

³³ Fifteen actions were selected from the 59 proposed.

³⁴ A total of 35 actions have been identified but 14 priority actions have been programed in the short-term

2.4.2 Sustainable Water Resource Management in the Lake Chad Basin Program

This GIZ program includes a whole project on adaptation to climate change. The project developed a climate change study for the entire Lake Chad Basin and carried out an inventory of production systems and the tested adaptation measures in area pilot zone (see chapter 0.3). This project supports the LCBC in the development of its regional climate change adaptation strategy and ensures the dissemination of information on climate change and adaptation measures.

2.4.3 Program to Rehabilitate and Strengthen the Resilience of Lake Chad Basin Systems (PRESIBALT)

The climate change adaptation and mitigation activities included in the program improve water flow in the Logone-Chari complex and reflooding in the Waza-Logone plain in Cameroon and the Komadougou-Yobé plain in Nigeria. These will include the rehabilitation of the floodplains of Waza-Logone over 445 km² and Hadejia-Nguru over 418 km², the development of lake transport routes on 1,600 km of critical areas in Komadougou-Yobé and Chari-Logone and anti-erosion measures in 50% of areas highly vulnerable to wind and water erosion.

Moreover, the program will increase the density of agro-hydrometeorological and aquifer observation networks and set up an early warning system. It will also carry out an integrated pest management program in subsistence agriculture: dissemination of Integrated Pest Management (IPM) techniques, small village irrigated areas and multifunctional platforms for gender promotion.

2.4.4 Lake Chad Development and Climate Resilience Action Plan

About 89% of the Plan's investments are primarily devoted to Lake Chad and its hinterland, covering an area of 300 km radius and inhabited by about 13 million people. In addition to spatial planning interventions (access to basic social services and transport), the plan includes projects that aim to directly strengthen people's capacities to adapt to climate change and reduce the vulnerability of the rural sector.

- **Support to producers and sectors:** education, inputs, support for POs, credit, light hydro-agricultural development, diversification of livestock systems and animal health.
- **Securing access to resources, conflict prevention and management:** land management projects for the multi-use of space and the securing of access routes to the lake reduce vulnerability to climate change;
- **Preserving the environmental capital of the lake:** preservation of the wood resource, reforestation of the banks and sustainable land and water management, enhancement of swamp biomass;
- **Better management and protection of the basin's water resources:** desilting of Komadougou-Yobé;
- **Dissemination of information, improving knowledge and monitoring of the environment:** rehabilitation of the surface hydrology monitoring network.

At present, the LCBC has no regional strategy for adapting to climate change. The Lake Chad Climate Change Development and Adaptation Plan is a strategy document in this area, but most investments are focused on land use planning and are concentrated in the immediate vicinity of the lake. Measures on climate change adaptation and mitigation are included in the SDLEEH, PRODEBALT and PRESIBALT.

2.4.5 Fishery management plan for the Lake Chad

The Lake Chad Fishery Management Plan aims to improve current management and monitoring systems through the application of the Ecosystem Approach to Fishery. With the objective of "ensuring the protection and sustainable use of Lake Chad's resources and ecosystems to increase the contribution of fishery to food security, poverty reduction and income enhancement at all levels", all measures under operational objective 5 (which is part of the Management objective 3) focus on adaptation.

The aim is to introduce and strengthen good practices for adaptation and resilience. Local practices for building resilience and adapting to climate change will be inventoried, improved and documented (e.g. development of aquaculture, small-scale village irrigation, promotion of beekeeping, etc.). The management plan also includes the development of local action plans for adaptation and resilience to climate change and the establishment of a sustainable financing mechanism for adaptation and resilience action plans to climate change and disaster risks. To reduce the vulnerability of fishing communities to climate change and disaster risks, revolving funds or other appropriate mechanisms such as resilience funds will be established in each country to support their activities, particularly for the northern basin, which is more exposed to the risk of drying up.

2.4.6 Pastoral Development Plan for the Lake Chad Basin

Climate constraints are one of the main factors limiting the development of pastoral activities. Therefore, all actions selected under the following components of the LCBC pastoral development plan contribute to the adaptation of pastoralism to climate change:

- Conservation and restoration of forage resources;
- Securing pastoral mobility;
- Construction of pastoral infrastructure;
- Capacity building;
- Strategic support for pastoral activity.

2.5 Climate change adaptation initiatives of the Economic Community of Central African States (ECCAS)

The Economic Community of Central African States (ECCAS) is aware that climate change poses a threat to the development of its member countries. The strategic axis 5 of its general policy on the environment and natural resource management deals with the fight against climate change, land degradation and desertification. Actions will focus on continuing the fight against climate change in the context of the implementation of the Paris Agreement and Decision, the promotion of alternative livelihoods, the establishment of models for the preservation of natural resources and the implementation of action plans to combat land degradation, drought and desertification.

2.5.1 Sub-Regional Action Programme to Combat Land Degradation and Desertification in Central Africa (PASR/LCD-AC)

The strategic objective of the PASR-AC is to ensure food security, energy security and improve the quality of life of rural and peri-urban populations. The various priority areas of intervention deal with adaptation. It is about:

- Concerted management of cross-border transhumance;
- Sustainable management of shared water resources;
- Information management (early warning, information, training and communication).

2.5.2 Central African Regional Strategy for Risk Prevention, Disaster Management and Adaptation to Climate Change

Three of the priorities in this strategy are directly related to adaptation to climate change³⁵. It is about:

- Strengthen ECCAS' managerial and operational capacities in disaster risk reduction and adaptation to climate change by providing the necessary human, technical and financial resources;
- Strengthen the capacities of universities and research institutions that develop initiatives in the field of disaster risk reduction and management, as well as adaptation to climate change.
- Promote the integration of risk reduction related to climate variability and future climate change into strategies of Regional Climate Centers (RCCs).

2.5.3 Central African Forest Commission (COMIFAC)

Created in March 1999, the commission is responsible for coordination, harmonization and decision-making in the conservation and sustainable management of forest and savannah ecosystems in Central Africa. COMIFAC has developed several climate change adaptation programs and projects, including:

- The Programme "Support to the conservation of ecosystems in the Congo Basin (PACEBCo)". This programme has four components: institutional support to COMIFAC and its partners; community rural development; biodiversity conservation and management; and climate change adaptation and programme management.

³⁵ CCEAC. (2016). *Stratégie régionale Afrique Central pour la prévention des risques, la gestion des catastrophes et l'adaptation aux changements climatiques*. Libreville, Gabon: Communauté Économique des États de l'Afrique Centrale (CEEAC).

- The ROSE project “Contribution for Population Mitigation and Adaptation to Climate Variability and Change (CAPV-2C)” aims to improve the living conditions of populations and fight global warming in the Region.
- The Gender Strategy for REDD+ and adaptation to climate change in Central Africa: it aims to take into account gender and the effective involvement of women in REDD+ processes and adaptation to climate change in the COMIFAC area. This strategy will strengthen the role of women and other populations at high risk of vulnerability in the development, implementation and monitoring of national and sub-regional REDD+ and adaptation policies and strategies.

2.6 Initiative of the Economic Community of West African States (ECOWAS)

Several climate change adaptation initiatives have been developed in the Economic Community of West African States; the most significant are:

2.6.1 Permanent Interstate Committee for Drought Control in the Sahel (CILSS)

CILSS was created in 1973 by 9 countries of the Sahel region (Burkina Faso, Cape Verde, Chad, Gambia, Guinea Bissau, Mali, Mauritania, Niger and Senegal) to fight desertification in the Sahel, with a strong focus on food security. CILSS now includes 6 major programs covering: food security policies and strategies, natural resource management and desertification control policies and strategies; agro-hydro-meteorological information; training on these areas; agro-socio-economic research and population-development research. As an observer member of the Conventions to Combat Desertification and Climate Change, CILSS received the mandate from ECOWAS to take charge of all environmental issues in all countries of the sub-region on 21 December 2006.

2.6.2 Environment and Climate Strategy 2015 – 2019 of the West African Development Bank

The strategy aims to make the environment a new growth area for the Bank. One of the three (3) specific orientations of the strategy deals with climate, namely "developing effective financing and resource mobilization tools and mechanisms to support environmental management and the fight against climate change".

2.6.3 Strategic Programme for Vulnerability Reduction and Adaptation to Climate Change in West Africa.

The programme plans to develop and strengthen resilience and adaptation capacities in the sub-region to address climate change and extreme weather events through:

- Strengthening the scientific and technological capacities of the subregion in reducing vulnerability to climate change;
- Promoting the integration of climate change issues into the formulation of development policies, strategies, programs and projects at the sub-regional and national levels;
- Developing and implementing sub-regional and national climate change adaptation programs and projects.

The ECOWAS "Policy and Mechanisms on Disaster Risk Reduction" clearly highlights the issue of adaptation to climate change in its focus area no. 4 and priority actions have been dedicated to it³⁶:

- Ensure the integration of disaster reduction into the implementation of the ECOWAS Agricultural Programme by focusing on gender issues in order to ensure food security for better disaster resilience;
- Support efforts to integrate disaster risk reduction strategies into climate change adaptation, including drought management and combating desertification.

The "Elements of a Regional Climate Change Adaptation Strategy based on the risk-sharing approach" of West Africa. This initiative aims to reduce West Africa's vulnerability to

³⁶ CEDEAO. (2006). *Politique et Mécanisme de la CEDEAO sur la Réduction des Risques de Catastrophes*. Abuja, Nigeria: Communauté économique des États de l'Afrique de l'Ouest (CEDEAO).

climate risks by sharing the costs of climate change adaptation at sub-regional and regional levels³⁷.

2.6.4 AGRHYMET Regional Centre

Created in 1974, the AGRHYMET Regional Centre is a specialized institution of the Permanent Interstate Committee for Drought Control in the Sahel (CILSS). Its main objectives are:

- Contribution to food security and increased agricultural production in CILSS and ECOWAS member countries;
- Support for improving the management of natural resources in the Sahel and West Africa region by providing information and training to development actors and their partners in the fields of agro-ecology in the broad sense (agro-climatology, hydrology, plant protection, etc.).

It is a regional tool, focusing on science and technology applicable to the sectors of agricultural development, rural spatial planning and natural resource management.

³⁷ UICN. (2004). *Réduire la vulnérabilité de l'Afrique de l'Ouest aux impacts du climat sur les ressources en eau, les zones humides et la désertification - Eléments de stratégie régionale de préparation et d'adaptation*. (M. Niassé, A. Afouda, & A. Amani, Eds.). Gland, Suisse et Cambridge, Royaume-Uni: Union mondiale pour la nature (UICN). <https://doi.org/10.1016/j.jacr.2011.10.002>

2.7 African initiatives for adaptation to climate change

The **World Bank's Africa Climate Business Plan**³⁸ identifies about ten areas where efforts can be intensified to help African countries achieve more resilient development. The third communication presents two opposing scenarios:

- A dry scenario that predicts, between 2011 and 2050, rainfall deficits resulting in: reduced crop yield and loss of production; erosion of productive land and silting of rivers; damage to agricultural infrastructure, reduction in the length of the agricultural season and the appearance of crop pests
- A wet scenario, between 2011 and 2050, characterized by years of annual rainfall in excess of normal annual rainfall over the 1961-1990 period. The potential impacts are: abundant rainfall with many potential positive effects that can contribute to improved agricultural production; increased frequency of flooding of crop areas; asphyxiation and reduced plant development due to excess water; emergence of diseases and some crop pests related to excess water conditions; and reduction and/or total loss of agricultural production and sometimes even human lives in areas affected by climate change-related flooding.

The plan builds on the World Bank's overall commitment to supporting climate-resilient and low-carbon development in developing countries and its strong contribution to technical and financial assistance to support climate action in sub-Saharan Africa.

The **ClimDevAfrica** programme led by the African Union (AU), the United Nations Economic Commission for Africa (UNECA) and the African Development Bank (AfDB), established in May 2010, became operational in February 2015. Its objective is to fully use the potential of science and climate services to contribute to the achievement of the Millennium Development Goals (MDGs)³⁹.

The **African Climate Change Strategy** of May 2014 builds on four thematic cornerstones, namely: climate change governance; promotion of research, education, awareness raising and extension; integration of climate change aspects into planning, budgeting and development processes; and promotion of national and regional international cooperation⁴⁰.

The **African Centre for the Applications of Meteorology for Development** (ACMAD): It is based in Niamey and serves the 53 African States. Created in 1987 by UNECA and WMO, it has been working since 1992 mainly on climate prediction (PRESAO programme: seasonal forecast in West Africa) at different scales of time (daily to monthly) and space (continental to national)⁴¹.

³⁸ The World Bank. (2015). *Accelerating Climate-Resilient and Low-Carbon Development - The Africa Climate Business Plan*. Washington DC, USA: International Bank for Reconstruction and Development / The World Bank.

³⁹ See: <http://www.climdev-africa.org/>

⁴⁰ CMAE. (2014). *Stratégie africaine sur les changements climatiques*. Conférence ministérielle africaine sur l'environnement (CMAE), Union africaine (UA).

⁴¹ See: <http://www.acmad.net>

2.8 International policy on adaptation to climate change

The United Nations Framework Convention on Climate Change (UNFCCC) adopted and opened for signature in 1992 at the Rio de Janeiro Conference is the international framework for adaptation to climate change. The highest authority of the UNFCCC is the Conference of the Parties (COP). It brings together all signatory countries each year to take decisions on the implementation of the Convention. The ultimate objective of the UNFCCC and related agreements is to "*stabilize greenhouse gas concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with the climate system....* ».

Adaptation and mitigation have been presented since 1992 as the two pillars of international climate policy enshrined in the UNFCCC. According to Article 4 of the UNFCCC, signatory countries commit to the implementation of national or regional adaptation measures, cooperation on adaptation to climate change and assistance to particularly vulnerable developing countries.

Furthermore, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988 to collect and evaluate scientific data on the topic of climate change. The IPCC is the supreme body for global scientific governance on climate.

2.8.1 Some of the decisions taken by the UNFCCC

First, in 1995, at the first Conference of the Parties (COP 1) in Berlin, a three-step approach was defined for adaptation actions. Steps I and II consist of identifying the most vulnerable countries or regions and developing policy options to strengthen adaptive capacities. Step III includes concrete measures to facilitate adaptation to climate change.

In 1998, the Global Environment Facility (GEF) was designated as the operational entity of the UNFCCC financial mechanism. It is therefore the authority which will manage adaptation funding from the UNFCCC initiated in 2001, at the COP 7 in Marrakech, with the establishment of three adaptation funds:

- the Least Developed Countries Fund (LDCF), which has contributed to the preparation and implementation of national programs of action for adaptation to climate change (NAPAs);
- the Special Climate Change Fund (SCCF) set up to finance Adaptation, Technology Transfer and Economic Diversification programs;
- the Adaptation Fund (AF), the successor to the Special Fund for Strategic Priority on Adaptation (SPA), which closed in November 2008 and financed pilot and demonstration projects that meet local adaptation needs.

Since the Bali Roadmap in 2007, adaptation has gained undeniable political weight. It is driven by developing countries, which strongly link adaptation and development issues. Its progress is also confirmed by the reports of the United Nations and the IPCC, which stress that the consequences of climate change will be costly and global (food security, climate refugees, etc.).

At the COP 14 in Poznań in 2008, the roles of the GEF and the World Bank in the management of the Adaptation Fund were confirmed. The Fund's strategic policy is also defined, particularly the possible direct access of developing countries to the Fund. The Green Climate Fund instrument was also adopted by the Conference of the Parties to the Climate Convention in Durban at the end of 2011. The creation of this fund responds to a strong demand from developing countries for a fund that would provide large-scale financing for developing countries' transition to a low-carbon and climate-resilient development model (Figure 9).

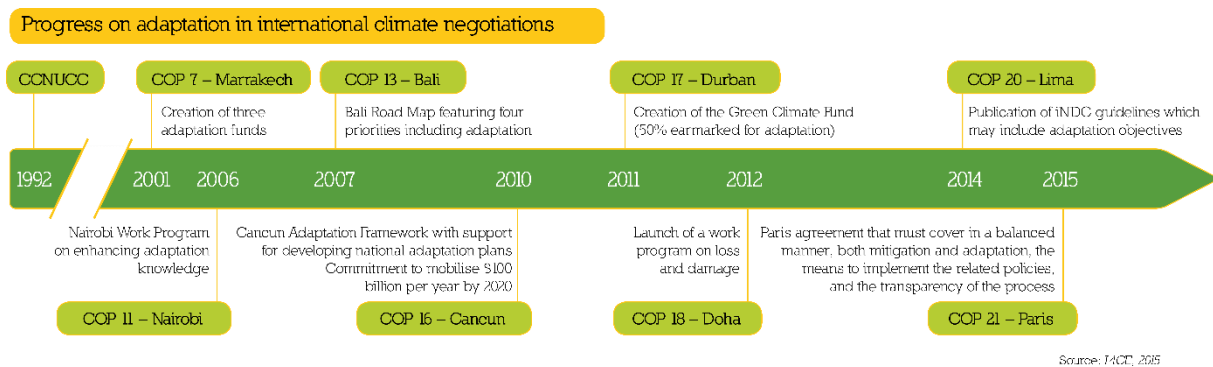
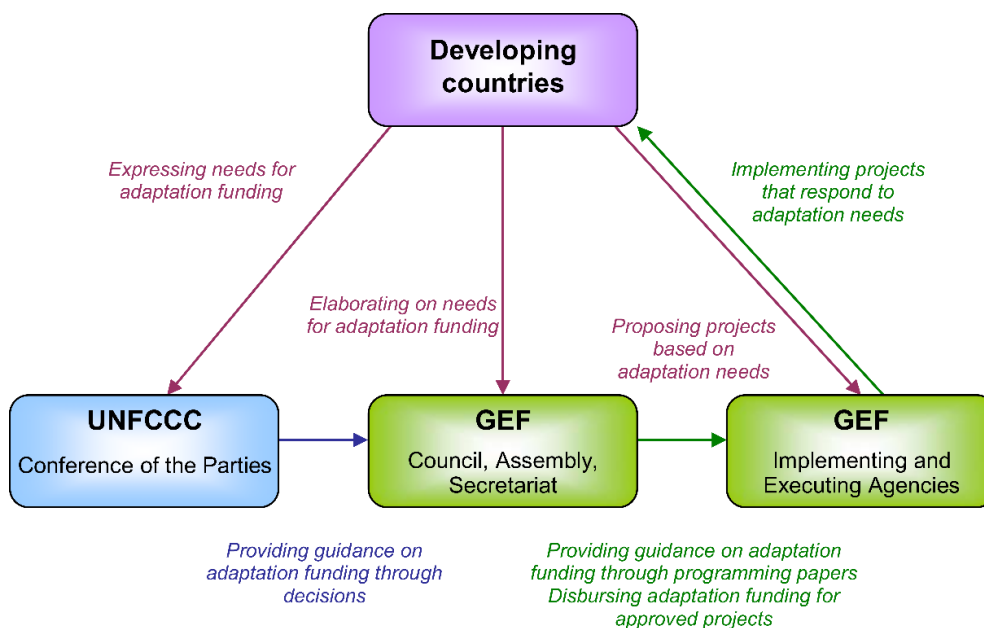


Figure 9: Progress on adaptation in international climate negotiations

2.8.2 Governance of the GEF by the UNFCCC and funding of adaptation measures

The selected projects are the result of a specific governance system between developing countries, the UNFCCC and the GEF. This system is valid for the three specific funds managed by the GEF (Special Fund for Strategic Priority on Adaptation, SCCF, LDCF). Developing countries negotiate with both the UNFCCC and the GEF on general guidelines for the use of funds. They also propose projects in response to their adaptation needs to implementing and executing agencies of the GEF (Figure 8). These agencies, responsible for project proposals and management, are: UNDP, UNEP, World Bank, ADB, AfDB, IDB, IFAD, FAO, UNIDO.



Source: Mission Climat of Caisse des Dépôts, adapted from Möhner and Klein (2007)

Figure 10: GEF management

2.9 National climate change adaptation frameworks

The structure in charge of climate change issues varies from one country to another: it is either the Ministry in charge of the Environment or the National Environment Council under the authority of the Prime Ministry.

2.9.1 Cameroon

In Cameroon, the main ministries concerned are the sectoral ministries directly affected by climate change or especially vulnerable to climate hazards (agriculture, livestock, forestry, fisheries, water resource management). In addition, MINEPAT and MINFI are key actors because of their multisectoral base and their recognized vocation and expertise in planning, programming and budgeting.

MINEPDED is the key ministry for climate change adaptation. It provides leadership of the process as the UNFCCC's Political and Operational Focal Point and is responsible for the design and implementation of ecological monitoring and warning systems, in liaison with the relevant administrations and the development of programs in the context of climate change.

The mission of the National Observatory on Climate Change in Cameroon (ONAC) is to carry out prospective analyses aimed at proposing a vision on climate change and to provide meteorological and climatological data to all relevant socio-economic sectors. It also initiates and promotes studies on the identification of impacts and risks related to climate change and proposes measures to mitigate and/or adapt to the adverse effects and risks related to climate change. The National Assembly and the Senate are responsible for drafting laws and monitoring government action. They are key actors in the development of standards.

Among its decentralized services, MINEPDED's regional delegations are the most involved in terms of adaptation to climate change. Decentralized territorial authorities (CTD) must integrate CC adaptation into community economic and social development. They will therefore need to be sensitized on climate change and adaptation in their territories.

The private sector, the civil society, traditional and religious authorities and the media, national research centers and academic institutions, international technical and financial partners (TFPs) as well as individuals and households are actors who support the implementation of adaptation strategies to the CC.

2.9.2 Niger

After the signing of the United Nations Framework Convention on Climate Change (UNFCCC) on 12 June 1992 and its ratification on 25 July 1995, Niger drew up a National Environment Plan for a Sustainable Development (PNEDD), which is the guiding framework for all environmental and sustainable development policies. Their implementation and monitoring are coordinated by the National Environment Council for a Sustainable Development (CNEDD). Created in January 1996 and placed under the supervision of the Prime Minister's Office, the CNEDD coordinates six (06) priority programs of the PNEDD, including the Climate Change and Variability Programme (PCVC).

Specialized technical commissions, including the National Technical Commission on Climate Change and Variability (CTCVC), were created in 1997 to support the PNEDD. The CTCVC is composed of representatives of public services and government services, universities, non-governmental organizations, research institutions and the private sector. Its mission is to support the Executive Secretariat of the National Environment Council for Sustainable Development (ES/CNEDD) in the implementation of the Climate Change and Variability Programme.

The Ministry of Hydraulics and Environment (MHE), the Ministry of Agriculture (MAG), the Ministry of Livestock (MEL) and the Ministry of Mines and Energy (MME) are the main institutions in charge of implementing measures to adapt to climate change; the National Council on Environment for Sustainable Development is responsible for coordination.

2.9.3 Nigeria

The Federal Ministry of the Environment is responsible for environmental protection and natural resource conservation. It is the agency in charge of adaptation to climate change. The Climate Change Department, which emerged from the transformation of the Special Climate Change Unit (SCCU) under the Permanent Secretariat of the Federal Ministry of the Environment in December 2011, has the mandate to coordinate the national implementation of the UNFCCC, protocols and other legally binding agreements for the implementation of climate change-related activities.

Given its central role, the Federal Government will need to put in place a legal framework for adaptation in Nigeria. It must integrate climate change adaptation into all existing and new national development plans, into the country's vision and into all sectoral policies and programs.

For agriculture, this integration should involve the ministries responsible for Planning, Finance, Environment, Agriculture, Water Resources, Science and Technology. It actively and effectively responds to global and regional initiatives on adaptation to climate change and is responsible for planning, priority setting, implementation, fundraising and evaluation.

Each state will establish a ministry or agency to coordinate climate change adaptation activities, giving a significant role to adaptation in all development plans and in all sectoral policies and programs. The ministry/agency must also ensure that adaptation is considered in the preparation of the State's annual budget, actively and systematically strengthen inter-ministerial and inter-agency coordination and cooperation and create an enabling environment for private investment, including business opportunities promoted by climate change and adaptation options.

Local Governments, in collaboration with the State Government or Federal Government, are responsible for building the adaptive capacity of communities. The implementation of an awareness strategy will allow all stakeholders to actively participate in adaptation. Civil society organizations, households and individuals, the private sector, international organizations and donors are also important actors in CC adaptation.

2.9.4 Central African Republic

The National Committee for the Protection and Rational Use of the Environment established by Decree No. 89.047 of 23 February 1989 is the advisory body responsible for deciding on all matters relating to environmental policy. Together with the National Commission for the Environment and Sustainable Development (CNEDD) created by Decree n°94.124 of 26 April 1994, it is responsible for integrating the decision-making process on the environment and development within the framework of national and decentralized consultation and ensuring that sustainability is taken into account in economic development policies and strategies. The Committee has a Permanent General Secretariat under the direct authority of the Head of State. These structures are not yet operational.

The Government is responsible for mobilizing resources for the implementation of the adaptation policy. It can implement it directly or entrust it to an executive agency. For example, the implementation of the 10 adaptation projects proposed by the NAPA has been assigned by the Central African Government to the UNDP office in Bangui.

The Ministry of Agriculture and Rural Development is responsible for preparing the implementation of the project "Integration of Climate Change Adaptation in the Agriculture and Food Security Sector in the Central African Republic", which is the first priority of the NAPA. It is also responsible for the preparation of the National Communication on Climate Change. This ministry is supported by the Inter-Ministerial Committee on the Environment under the authority of the Prime Minister, whose secretariat is provided by the Ministry of the Environment and Transport, the Parliamentary Committee on Natural Resources and NGOs.

2.9.5 Chad

The issue of adaptation to climate change is the responsibility of the Ministry of the Environment, the main institutional actor in the sector, and particularly its Department of Climate Change Control (DLCCC), responsible for dealing with this issue. Among other things, the DLCCC must:

- investigate and analyze climate vulnerability per bioclimatic zones and geographical regions according to climate change;
- establish climate models to monitor and analyze climate change at the national level;
- identify and establish indicators of climate change impacts per bioclimatic zone and geographical region;
- ensure the follow-up of the various Conferences of the Parties (COPs) to the United Nations Framework Convention on Climate Change (UNFCCC) on adaptation and technology transfer.

The Director of Climate Change Control and the Managing Director of Meteorology are the two focal points of the United Nations Framework Convention on Climate Change in Chad.

The NAPA is carried out by the Ministry of Environment in collaboration with sectoral ministries such as the Ministry of Agriculture (Rural Engineering and Hydraulics, ONDR), the Ministry of Livestock, the Ministry of Communication, the Ministry of Higher Education and the National Observatory on Climate Change (ONCC). Some actions on the ground will be carried out by NGOs and local communities under the supervision of the Ministry of the Environment and the relevant sectoral Ministry.

Several agencies and programs under supervision carry out activities that are directly or indirectly "connected" to the fight against climate change. These include the National Agency for the Great Green Wall (ANGMV), the Special Environment Fund (FSE), which could be a relay for the Green Climate Fund, the Agency for Domestic Energy and Environment (AEDE),

the Rural Development and Environment Committee of the National Assembly and the Economic, Social and Cultural Council.

In addition to national institutions, parliamentarians' networks participate in debates on climate change at the African and Central African subregion level:

At the regional level, the Pan-African Parliamentarians' Network on Climate Change (PAPNCC) discusses Africa's position at international climate conferences. At the second summit, decisive steps were taken to strengthen the role of parliamentarians on climate change. These include: the integration of international conventions/protocols on climate change, the integration of climate change into national budgets to facilitate the implementation of climate change policies and laws, improved monitoring to ensure that international commitments by governments on climate change are implemented, the necessary engagement of parliamentarians to lead carbon sequestration through the legislative process and enact laws on disaster and risk management.

At the level of the Central African subregion, the Network of Parliamentarians for Sustainable Management of Forest Ecosystems in Central Africa (REPAR) **ensures the participation of Parliamentarians in the conservation and sustainable and beneficial management of Central Africa's dense and humid forest ecosystems**. The network makes recommendations to fight climate change, desertification and illegal logging.

The Designated National Authority (DNA)⁴²

Chad's Designated National Authority (DNA) is the main point of communication between Chad and the Green Climate Fund (GCF). The DNA ensures that the activities supported by the GCF are aligned with Chad's strategic objectives and priorities and contribute to the advancement of ambitious adaptation and mitigation action based on national needs. One of the key roles of the DNA is to provide a letter of recommendation from project leaders to accredited entities (CSE, AfDB) and a letter of recommendation from an entity that would like to be accredited to the GCF.

The DNA also issues the non-objection letter that will allow the project and project idea to be considered by the GCF Secretariat for evaluation and submission to the Fund for approval

The National Water Fund (FNE) and the Special Environmental Fund (FSE) are in the process of being accredited as National Implementation Institutions for the GCF.

⁴²<http://fvc-tchad.org/lautorite-nationale-designee-and/>

3 CONCLUSION

Observed and projected climate variability/changes in the basin are characterized by increasing temperatures, intra- and interannual variability in precipitation and decreasing vegetative period. Soil degradation, the drastic reduction of pastures, the deficit of the pastoral and fodder balance and the watering difficulties resulting from more frequent climatic extremes will lead to a decline in agro-silvo-pastoral production.

The populations of the basin, mainly farmers, and/or herders and fishermen, are particularly vulnerable to the consequences of this context because of the low adaptive capacity resulting from a high level of poverty and the importance of the rural sector's contribution to GDP (between 20 and 57%) and employment (it employs more than 50% of the active population). This situation is aggravated by the low budget allocated to this sector, which does not allow for effective supervision and monitoring of producers as well as for significant and sustained interventions.

To mitigate the effects of climate change on populations, the countries of the basin have strategic adaptation documents (NAPAs, NAPs). These documents have made efforts to cover the vital sectors of the economies and are in line with the objectives and priorities of the National Poverty Reduction Strategies. However, little attention has been given to transboundary water management issues, sub-regional cooperation in observations and forecasts, dissemination of context-specific varieties and conservation management techniques for water and soil. It is therefore urgent to develop these aspects in a regional strategy for adaptation to climate change.

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ANNEX

Annex 1: Definition of concepts

Climate change refers to the variation in the state of the climate and/or the variability of its properties that persists for a long period of time, usually decades or more. **Climate changes** may be due to natural internal processes or external forcings, including modulations of the solar cycle, volcanic eruptions or persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC, 2014). It should be noted that the United Nations Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as "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". The UNFCCC thus distinguishes between climate change due to human activities that alter the composition of the atmosphere and climate variability due to natural causes.

According to IPCC (2001), exposure is the nature and degree to which a system is subject to significant climatic variations. It also includes the presence of people, livelihoods, species or ecosystems, environmental functions, services and resources, infrastructure or economic, social or cultural goods in areas that are likely to be adversely affected.

Risks are the potential and uncertain consequences of an event where something of value is at stake, recognizing the diversity of values. Risk is often represented as probability of occurrence of dangerous trends or events that are amplified by the consequences of such phenomena when they occur. Risk arises from the interactions of vulnerability, exposure and hazards (IPCC 2015).

Sensitivity is the degree to which a system is influenced, adversely or beneficially, by climate variability or change. According to GIZ (2015), "sensitivity is typically shaped by the characteristics of a system's natural and/or physical environment, including topography, the capacity of different soil types to resist erosion and the type of land cover. It also refers to human activities which affect the physical constitution of a system, such as cultivation methods, water management, resource use and population pressure".

Vulnerability to climate change is the "Degree to which a system is likely to be adversely affected by the adverse effects of climate change, including climate variability and extreme events. Vulnerability depends on the character, magnitude, and rate of climate change to which a system is exposed, as well as its sensitivity and adaptive capacity" (Parry et al. 2007).

Adaptation is the process of adjusting natural or human systems in response to present or future climate stimuli and their effects, in order to mitigate adverse effects or exploit beneficial opportunities (IPCC, 2001, 2014). For Magnan A., (2014), **adaptation** can be considered as a process. "The adaptation process refers to the mechanisms of adaptation, i.e. the system-specific logics that explain the evolution of the various forms that adaptation can take (projects, programs, plans, policies)".

Adaptive capacity is the degree to which a system adjusts to climate change (including climate variability and extremes) in order to mitigate potential damage, take advantage of opportunities or respond to consequences. According to GIZ (2015), it is measured through: knowledge (level of education and awareness on climate change, dissemination of climate and meteorological information); availability and accessibility of technological opportunities for adaptation; institutional, legal and governance and economics (GDP), activity/unemployment rates; domestic incomes, food expenditures.

Resilience is the ability of social, economic or ecological systems to cope with, respond to, and reorganize themselves in order to maintain their essential functions, identity and structure, while maintaining their capacities for adaptation, learning and transformation (IPCC, 2014).

Rural sector: All activities that contribute to crop, livestock, fisheries and forestry production, the production of environmental services in rural areas and the sustainable management of rural areas, natural resources and the environment.

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