

ANGOLA

**NATIONAL ADAPTATION PROGRAMME OF
ACTION**

**UNDER THE UNITED NATIONS FRAMEWORK
CONVENTION ON CLIMATE CHANGE (UNFCCC)**

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This project is an excellent reflection of the efforts of the Angolan Government in honouring its international commitments within the scope of climate change adaptation, and of its responsibility in the area of sustainable development, the fight against poverty and millennium development objectives.

ABBREVIATIONS

PANA – National Adaption Programme of Action
UNFCCC- United Nations Framework Convention on Climate Change
GEF- Global Environment Fund
EEZ – Exclusive Economic Zone
GDP – Gross Domestic Product
UNEP- United Nations Environment Programme
IPCC- Intergovernmental Panel for Climate Change
INAMET- National Meteorology and Geophysics Institute
UNDP- United Nations Development Programme
DRC – Democratic Republic of Congo
ENOS – El Niño Oscillation
NFD – National Fisheries Department
NPHD – National Public Health Department
ICCT – Institute to Fight and Control Trypanosomiasis
IUCN – International Union for Conservation
GCM – Global Climate Model
MINADERP- Ministry of Agriculture, Rural Development and Fisheries
CEIP – Population Studies and Research Centre
LESRA – Engineering Laboratory of Separation, Chemical Reaction and Environment
CNRF – National Plant Genetic Resources Centre
CEDUMED – Centre for Advanced Studies in Education and Medical Training
CPFGE – Education Research, Training and Management Centre
UNESCO – United Nations Organization for Education, Science and Culture
UNFPA – United Nations Population Fund
SABONET – Southern Africa Botanic Network
NDA- National Designated Authority
SADC- Southern African Development Community
ISCED – Higher Science and Education Institute
EPL – Exploration and Production Laboratory
ANU – Agostinho Neto University
LDCs – Least Developed Countries
MINAMB- Ministry of the Environment
MINEA- Ministry of Energy and Water
SFP- Strategy for Fighting Poverty
NGO- Non-Governmental Organization
INIP- National Institute for Fisheries Research
MCE- Multi-sectoral Commission for the Environment
HIV – Human Immunodeficiency Virus
AIDS – Acquired Immune Deficiency Syndrome

EXECUTIVE SUMMARY

Climate change, although often presented as only a problem related to the environment, is in fact a challenge to socioeconomic development. Vulnerability to climate variability and climate change deeply affect the development of the country.

Climate is characterised by the statistical pattern of different atmospheric elements, such as temperature, humidity, atmospheric pressure, wind and rainfall, which occur in a given region over long periods of time. Crops and, in fact, histories of given communities depend greatly on the climate conditions to which they are subject.

There have been a number of historical climate changes globally, such as warming and cooling periods. Some bibliographies state that this is due to a number of reasons, some depending on natural causes such as; change in solar emissions, orbital variation of the earth, volcanoes, and even due to impacts of meteorites; but in spite of this, human activities have had a greater impact because they alter the composition of the world's atmosphere resulting in unnatural climate variability observed over comparable periods.

Climate change, due to the extent of the impact it may have on ecosystems and on a multiplicity of sectors of human activity, is an issue that has been receiving the world's attention. On the other hand, issues related to climate change are still difficult to understand for Angolan society as survival-related issues during the conflict did not allow for the formation of a conscience on environmental issues for most of the population.

The Angolan Government presents the National Climate Change Adaptation Programme of Action – NAPA, which was developed according to the guidelines set out in decision 28/CP.7 of the United Nations Framework Convention on Climate Change regarding the annotated guidelines for the creation of the National Adaptation Programmes of Action for the least developed countries. The NAPA was developed based on the process set out in the guidelines, including through regional consultations and multi-criteria prioritization of national adaptation priorities, as well as based on experience gained by other countries in the development of their NAPA, and on Angola's own development priorities. The NAPA emerges as an instrument aimed at communicating the urgent and immediate adaptation challenges facing the country.

The drafting of this NAPA was undertaken under the responsibility of the Angolan Government with support of the United Nations Environment Programme (UNEP) and the Global Environment Fund (GEF).

Country context

The Republic of Angola is located in the African continent, in the southern region. It shares borders to its north with the Republic of Congo and the Democratic Republic of Congo, to the east with the Democratic Republic of Congo and the Republic of Zambia, to the south with the Republic of Namibia and to the west with the Atlantic Ocean.

Its political-administrative division includes close to 1,671 towns, 376 Communes, 163 Municipalities and 18 Provinces, i.e: Cabinda, Zaire, Uíge, Luanda, Bengo, Cuanza-Norte, Malanje, Lunda-Norte, Lunda-Sul, Cuanza-Sul, Benguela, Huambo, Bié, Moxico, Namibe, Huíla, Cunene and Cuando-Cubango. The population is calculated at 18,082,000 inhabitants (NSI 2010). Population density is approximately 13.2 inhabitants per km² which is low in comparison with the African average, which is of 21 inhab//km². The Angolan population is very young. Close to 50% are under the age of 15, and 60% are under the age of 20. 93% of the population is under the age of 50.

The climate is quite diversified resulting from the combination of a number of factors, such as latitude (from 4 to 8 degrees), altitude (from 0 to 2,620 metres), the landscape and the maritime currents, notably the Benguela Cold Current. In general, the climate is characterised by two more or less well-defined seasons: The dry “Cacimbo” season is cool, starting in June and ending in September, and the warm “Rainy” season – humid and rainy from October to May.

Angola has many major river basins, such as those of the Rivers Zaire, Cuanza, Zambeze, Cunene, Cubango and other smaller ones which flow directly into the Atlantic Ocean. Angola is a multicultural and multilingual country.

The country is divided into two differentiated climatic regions:

- **Coastal region** – relatively humid with an average rainfall of over 600 mm, with decreasing rainfall amounts from north to south.
- **Inland region**, subdivided into three zones, i.e.:
 - The *north* part with heavy rainfall and high temperatures;
 - The *plateau* zone, characterised by average annual temperatures close to 18° C, with high minimum temperatures in the dry season; and
 - The *southwest* zone is semi-arid due to its closeness to the Kalahari Desert with low temperatures in the hot season given the great continental tropical air masses and the influence from the Benguela Cold Current.

Economic and development context

Angola's economy is characterised by high levels of growth but is essentially dependent on the oil sector, which represents 55% of the GDP and 95% of exports. Despite its dependence on the oil sector, the country presents a remarkable macroeconomic stability which is reflected on the stability of its national currency, among others. The income indices of the Angolan population are very low. There are also obvious discrepancies in the distribution of the national income, consequences of the prolonged conflict that the country recently underwent. The high level of poverty of the population is reflected by its inadequate access to food, drinking water, sanitation, education, health, electric energy and other commodities. Rural populations experience higher levels of poverty than populations in urban centers.

Major sectors

The objectives defined in the Angola Development strategy for 2000 – 2025 aim:

- To promote employment and enhance human resources;
- To construct a more fair and equitable society;
- To guarantee the sustainable use of the environment, natural resources and to fight desertification; and
- To build up competitiveness and develop the private sector.

In order to accomplish these objectives a number of preparatory actions related to all areas of national life, priorities for basic infrastructures (access roads, energy production, utilities networks for human settlements, structuring of general, technical, professional and higher education, structuring of health, telecommunications and agriculture sectors) require implementation.

Farming, livestock, forestry and fisheries sectors

The country has abundant natural resources essential for the development of its agriculture, with close to 57.4 million hectares of arable land, of which only between 5 and 8 million hectares are used.

Before independence, agriculture was the main sector of the economy and the country was a great exporter of corn, cotton, sisal and especially coffee. Currently agriculture is predominantly a subsistence activity for millions of small farmers who plant an average of 1.4 ha per family in two or three plots of land; the planted area increases slightly every year.

Fisheries contribute close to 7.8 % of GDP in Angola. In 2001, 20% of the catch (50 thousand tons) came from small-scale fishing and 80% (190 000 T) from semi-industrial and industrial fisheries.

Energy sector

Angola, due to its hydrographic characteristics, is the holder of potential low-cost hydroelectric energy, evaluated at 18.000 Gwh, which could be distributed throughout the national territory to cover current and future needs, and to export surplus to countries in the region.

The geographic energy systems distribution of the Angolan Provinces are as follows:

- North System: Luanda, Bengo, K. Sul, K. Norte and Malange
- Central System: Benguela
- South system: Huíla and Namibe
- Isolated systems: Cabinda, Huambo, Bié, Zaire, Kuando Kubango, Cunene, Moxico, Lunda Norte, Lunda Sul and Uíge.

Access to electricity remains sparse in Angola, with an estimated 8 to 20% of population connected to the electricity grid (IEA, 2006). Many households have access to fuel or gas-powered generators, but electricity remains expensive for many users, and inaccessible in many rural areas, prompting many illegal connections, and continued biomass-based energy supply (woodfuels).

Water sector

Due to its geographic location, Angola is very rich in water resources. According to the Water Sector Development Programme (Ministry of Energy and Water – MINEA, MINEA, 2004), the yearly average run-off is calculated at 140 million m³ (140 km³). As to the potential availability of groundwater, according to FAO/aquastat 1995, to 140 km³/year of run-off a year one must add 58 km³/year of ground water, of which 95% feeds the rivers, and 5% flows into the sea.

In Angola there are more 47 hydrographic basins flowing into 5 main strands. These are:

- Zaire which represents 22%;
- Atlantic represents 41%;
- Zambeze which represents 18%;
- Okavango which represents 12%; and
- Etosha to the south.

Despite this apparent abundance, access to improved water sources and sanitation remains low, with 60% of urban populations having access in urban areas, and 38% in rural areas. Nearly 62% of rural dwellers therefore rely on traditional, sometimes inadequate water

supply. In rural areas, only 18% of rural population have access to improved sanitation facilities.

Education sector

The education indicators of Angola are among the lowest in Sub-Saharan Africa. Recent statistical data describes the Angolan population as demonstrating a very low schooling rate, high rates of school drop outs, high failure rates and low retention rates (students who remain in the system with success).

Access to education in the rural areas is of 25.1%, whereas in the urban environment it is of 40%. The school failure rate in the first three years of education is of 30-35%, and the average school drop-out rate is over 30%.

The illiteracy rate, which has reached, according to the Multiple Indicator Cluster Survey 2001, 33% of the population of over the age of 15, is also an indicator of the low level of schooling. The illiteracy level is higher in women, reaching 50 %.

According to United Nations indicators, the illiteracy rate for the population over the age of 15 was in the year 2000 of 58%, in comparison with an average of 38% for all Sub-Saharan Africa.

Health sector

Malaria continues to be the main cause of death in Angola, mainly in children under the age of 5. Anti-malarial treatment is not always available in the health network and, as it is not standardised there is a great recourse to self-medication with negative effects on subsequent resistance to medication. This disease is responsible for close to 35% of the demand for curative care and for 20% of maternal mortality.

Access to medical services is very low throughout the country, with a physicians density reported at 0.08 for every 1000 inhabitants. Not surprisingly, the life expectancy at birth is also among the lowest in the world, with 38 years on average for both men and women.

Bacterial and water-borne diseases such as bacterial and protozoal diarrhea, hepatitis A, typhoid fever, also represent an important part of the disease burden in the country.

Housing sector

Housing must be the sector with the greatest number of problems in terms of meeting the needs of national citizens, given that from national independence to 2000 little was done to increase the national housing stock. The results of this are the current difficulties in the

whole country of being able to buy or rent a residence, an especially disturbing problem for the youth.

With the advent of peace and the ongoing national reconstruction process since that date, in 2008 the Government launched a construction programme of one million dwellings covering the whole country, especially in the provinces with greater problems in terms of lack of technical staff, as a way to encourage recently trained youngsters to settle in those regions and areas.

Telecommunications and information technologies sector

The strategy for the sector aims to guarantee the expansion of infrastructures supporting the offer of diversified quality information and communication services, which must be available for society as a whole in every region of the country.

In the area of meteorology and geophysics the pursuit of adequacy in the provision of public services is pursued, emphasising operational aspects, cost-effectiveness of infrastructures and information networks, in articulation with research and development.

Past and future climate change in Angola

The impact of the Benguela Cold Current on the coast of Angola is manifested by the desert conditions of the Skeleton Coast and Namibe, the semi-arid conditions south of Benguela and the persistent fogs along the southern coast of Angola.

According to a United Nations Development Programme (UNDP) report, between 1960 and 2006 there has been an increase in the surface temperature in the area where Angolan territory is located of between 0.33 and 1.5 ° C per decade. There was a higher increase during the cool season, 0.47°C, than in the warm season, 0.22°C, per decade. During the period from 1960 to 2006, there was a decrease in the annual rainfall of about 2 mm per month (2.4%), fundamentally in the months of March, April and May and a decrease of 5 mm per month (5.4%) per decade.

The daily observations of temperature show significant increases in trends of hottest days in all seasons and every night, with the exception of the months of December, January and February. The main trends for temperature increase according to the Global Climate Model refer to 2060 with increases of between 1.2 and 3.2°C and 2090 with increases of about between 1.7 and 5.1°C. Yearly projections also indicate for Angola an increase in temperature of between 20-40% up to 2060 and between 25-65% up to 2090.

Sectoral vulnerabilities to Climate change

In order to draw up a climate projection in Angola, one has to take into consideration the interaction of the ocean – atmosphere systems and its implications on the climate of the region of Southern Africa. One of the main factors considered is the current state of the El Niño Oscillation (ONES) and the surface temperatures of the ocean (INAMET, 2010).

According to the 4th IPCC report, global models predict different scenarios on climate change on the African continent. In western Africa, a drop in annual rainfall of 20 to 40% was observed between 1930 and 1990.

The post-1970 period saw an anomalous increase in inter-annual variability of severe rainfall and droughts (Richard et al., 2001; Fauchereau et al. 2003). In different parts of Southern Africa (Angola, Namibia, Mozambique, Malawi, Zambia) a significant increase in severe rainfalls events was also observed (Usman and Reason, 2004), including signs of change in seasonality and extreme weather events.

Alterations in the Benguela Cold Current may have implications on inshore fishing, on communities and the fishing industry. Alterations in the hydrology of the rivers or changes in water temperature may have implications on river and lake fisheries.

The increase in temperatures has a negative impact on farming through the increase in evaporation and perspiration. Alterations in rainfall and hydrology affect dry farming and irrigation. The impacts will depend on the area of the country, the agricultural systems in each region and current vulnerabilities.

As noted in Angola's Initial National Communication (currently being finalized), there is little data that enables a rigorous estimation of expected climate changes in Angola. Climate models for the southern Africa region don't include Angola and the Democratic Republic of the Congo due to a lack of data from these areas, but there are a few models that include areas close to Angola (Shongwe et al, 2009. KNMI, 2006.) However, regional climate models indicate that the climate in Namibia and Botswana will be dryer in the future, and that Zambia, Malawi and northern Mozambique will have the same precipitation levels, or a rise, but with more torrential rains.

Expected Climate Change Threats and Impacts

Floods in Angola are a recurrent phenomenon. For example, the Cuanhama basins, and the city of Ondjiva, have been most seriously affected in the last 10 years. The city of Luanda has been affected since 2007 and the cities of Benguela and Namibe have suffered floods in certain years which have generally resulted in flooding of houses and commercial buildings and the interruption of transport for long periods, in part due to the growth of cities in risk areas.

In a number of rural areas the residents chose the riverbanks to live as they want to live close to fertile soils to grow their own food and to be close to waterways to be able to fish; yet they know it is dangerous to live close to rivers, they may lose their belongings when there are floods, there is an increase in water transmitted diseases and their way of life is vulnerable. Residents of the banks of the River Zambeze, and the riverbanks in the Province of Kunene recounted that in recent years flooding has become more frequent. Floods also cause massive crop failure and untenable health situations due to the proliferation of mosquitoes and other disease vectors.

Soil erosion, a problem existing in certain areas (especially urban and peri-urban) may be worsened by the occurrence of more intense rain. More soil erosion will likely have implications on sedimentation in river basins, leading to potential decrease in river fisheries, siltation, loss of arable soil and upland flooding, as well as, ultimately, impacts on coastal ecosystems. Soil erosion could also be exacerbated by an increase in the frequency and severity of **drought** episodes, which will also have an impact on crop yields and could lead to increased deforestation for expansion to make up for lost crops. Agro-climatological analyses reveal a decrease in the length of the rainy seasons in some locations, with frequent records of prolonged episodes of droughts during the rainy season.

The concentration of human settlements on the sea-coast increases the risk of flooding due to the rise in **sea-level**, combined with additional pressures from coastal storms, changes in tidal patterns. Despite a lack of historical data for sea levels and coastal status in Angola, based on available data three scenarios have been posited for sea levels estimating potential increases between 0.13 meters and 0.56 meters by 2090. This could therefore have significant impact on the many coastal cities and populations, infrastructure, road networks, building and properties as well as industrial and port infrastructures. Nearly 50% of the Angolan population resides along the coast.

In addition, the most probable effect of climate change on the northern part of the Benguela system are the changes in the frequency and amplitude of tropical intrusions (El Niño), changes in wind-driven currents, changes in wind stress and in the intensity of upwellings, gradual increase in surface temperature of seawater and sea-level, which will have implications on primary productivity of the ecosystems and as a result on the fisheries catch as well as exacerbating prevalent sea level rise and coastal erosion and accretion processes. Angola's climate is diverse and as a result its agricultural systems are adapted to diverse conditions. The farming systems were studied in the 70s and since then conditions have changed due to rural depopulation during the war and decapitalisation of farmers and peasants. There is insufficient information on the critical points in agricultural systems and how they can be affected by changes in temperature and rainfall patterns.

According to the IPCC 2007 report, a number of countries in Africa should see their potential in dry farming reduced by 50% until 2010 as a result of climate change with

severe results for food security and the nutrition of their populations. The report also estimates that in sub-Saharan Africa there will be losses in production, with a drop of between 2 to 7 of the GDP, rendering these countries more vulnerable.

In Angola the climate factor is essential for activities in the agricultural sector, a strong sector of the economy facilitating and promoting employment for most of the labour force, rural development, the livelihood of families and the fight against poverty. Rainfall dependency for most staple crops, combined with unsustainable land use practices and prevalent soil erosion will entail increased vulnerability of the agricultural systems in Angola, leading to significant impact on rural livelihoods.

The lack of water resulting from fewer annual rainfalls seriously affects production of two types of agricultural practices (dry and irrigation). A decrease in the rainfall trend and increase in temperature could provoke a climatic deficit with serious consequences for production, which would place most of the population in a state of severe food insecurity.

Other expected consequences of climate change could include a change in **disease patterns, vectors and distribution**. Higher temperatures may extend the amplitude and prolong the seasonality of vector borne diseases, especially malaria. Currently in locations the altitude of which is higher than 1,500 metres the risk of contracting malaria is less, but certain areas may have a more warm and humid climate in the future with a greater risk of expanding malaria. In Luanda, for example, with intense rains and floods in 2008, there was an increase in contaminated water associated diseases (cholera, gastrointestinal diseases and malaria).

High temperatures, rainfall variability, and an increase in severe weather events may also increase the degradation of building materials and **infrastructures**. The impact of heat could include the expansion of railway tracks and the melting of asphalt with greater frequency and other materials may be more easily damaged. If bridges and other ways of discharging excessive water were planned without taking into account an increase in the maximum flows of rivers, their capacity may not be sufficient to cope with large volumes of water, resulting in flooding of river banks (as was the case in the Province of Kunene in recent years).

Summary of the NAPA process

The structure of the National Climate Change Adaptation Programme of Action follows the guidelines contained in decision 28/CP.7 concerning the annotated directives for the establishment of the National Adaptation Programmes of Action in less developed countries (LDCs). The National Climate Change Adaptation Programme of Action aims to identify and meet the urgent and immediate adaptation needs that less developed countries are facing.

The drawing up of the National Climate Change Adaptation Programme of Action was undertaken by the Ministry of Environment for the Angolan Government and received the support of the United Nations Environment Programme (UNEP) and the Global Environment Fund (GEF).

The methodological basis of the NAPA exercise was based on the definition of climate and socioeconomic scenarios that were used to anticipate a number of future impacts and the consultation with local communities. The methodology used in the drafting of this document consisted of a bibliographical revision and meetings with institutions and communities considered vulnerable to climate change.

In order to characterise vulnerability in the whole country a geographical division of Angola into 5 geographical regions was opted for, each one representing a type of vulnerability. Visits were made to the provinces of Cabinda, Bie, Moxico, Kuando Kubango, Namibe and Cunene, as pilot areas for the participatory study of the following vulnerabilities:

- Province of Cabinda – vulnerability in relation to ecosystems, biodiversity and forests;
- Province of Bie – vulnerability in relation to food security and agriculture;
- Province of Moxico – vulnerability in relation to health and education;
- Province of Namibe – vulnerability in relation to the coastline, infrastructures and fisheries;
- Province of Kuando Kubango – vulnerability in relation to water resources;
- Province of Cunene – integrated vulnerabilities.

In each province the populations were consulted at 4 different levels, i.e. authorities, non-governmental organisations, private sector and the population of specific locations where greater evidence of the type of vulnerability was noticed.

The survey on the vulnerabilities included thematic meetings with previously identified specific areas. An overall characterisation of identified vulnerabilities was also conducted.

Objectives of the NAPA

The objective of the National Adaptation Programme of Action are to **identify and communicate the urgent and immediate needs of the country regarding climate change adaptation**, to increase Angola's resilience to climate variabilities and to climate change to ensure achievement of Poverty reduction programmes, sustainable development objectives and the Millennium Development Goals pursued by the Government.

The specific objectives are as follows:

- To serve as a simplified and direct communication channel of information concerning the urgent and immediate adaptation needs of Angola;
- To enhance the national capacity of Angolan specialists in the area of vulnerability and adaptation to climate change, thus guaranteeing an appropriate atmosphere for the implementation of UNFCCC- United Nations Framework Convention on Climate Change, and
- To facilitate capacity building for the preparation and implementation of activities concerning adaptation included in the First National Communication, and to address urgent and immediate adaptation needs.

Implementation Principles

The impact of climate variability and change on all socioeconomic sectors of Angola may seriously compromise the efforts of current economic growth, as well as sustainable development of adequate and immediate adaptation measures are not taken.

Angola signed the United Nations Framework Convention on Climate Change and the Kyoto Protocol and drew up a national implementation strategy with regard to the convention and the protocol, where the drafting of the National Climate Change Adaptation Programme of Action is a fundamental tool to implement this strategy.

The NAPA is in conformity with the priorities of the National Plan 2010/11, the objectives outlined in the Angola 2025 report and the principles addressed in the National Strategy on climate change. It therefore includes activities which cover sustainable development, notably training and capacity building, technology and knowledge transfer and attracting foreign investment for:

- Taking precautionary steps – to anticipate, prevent or minimise the causes of climate change and mitigate its harmful effects, including the cost-efficiency principle of those measures. The measures to be taken must consider the socioeconomic aspects of the country, enclose all economic sectors of the country whose activities have direct or indirect consequences on climate change;
- Institutional cooperation – Efforts to fight against climate change may be undertaken in cooperation between different governmental departments, the private sector and environmental organisations of civil society. This cooperation must also include the principle of international cooperation to attain certain goals; and

- Integration – measures to fight against climate change shall be appropriated and integrated in the economic development programmes of the Country.

Adaptation measures and capacities

Adaptation is the adjustment in natural or human systems to respond to real or expected climate stimuli or their effects in order to mitigate losses or exploit beneficial opportunities. This National Adaptation Programme of Action is the Government of Angola's first attempt at defining its adaptation needs, the capacity gaps it may have, and the priorities to be addressed in light of existing impacts and impending climate changes.

Unfortunately, the projections for rainfall, run-off and soil humidity in the future are still very uncertain. There is still not enough information on the possible impacts of climate change in Angola at national or sub-national level but neither is it appropriate to suppose that the climate and hydrological conditions of the past will continue into the future.

In every area, it is therefore necessary to have a better understanding of the systems affected by climate change, the vulnerabilities of these systems and to test strategies to reduce these vulnerabilities in the local communities. There is currently insufficient knowledge, scientific research, or data to be able to concretely assess the specific amplitude of impacts expected on water, natural systems, soil, forests or coastal zones. Furthermore, there is insufficient data and technical capacity available in climate monitoring to be able to emit legitimate and timely forecasts, early warnings, let alone long-term projections.

The NAPA was developed using a combination of approaches, including documentary review, analysis by experts, and consultations in various regions of the countries. Based on available knowledge and priorities expressed during the consultations, the NAPA has determined a long and short list of adaptation priorities. A total of 30 potential adaptation responses to the threats listed above were originally listed. A shorter list of fifteen priorities was then determined using a summary multi-criteria analysis process that considered the costs and benefits of each proposed response. The list of 15 priority adaptation responses is as follows; project profiles for the first 5 priorities have been provided in the Annex, as per the NAPA guidelines.

1. Promote alternative renewable energies for avoided deforestation;
2. Promote SLM for increased agricultural yields;
3. Ensure basis access to health services and health monitoring;
4. Study the Vulnerability of fish sector and possible modifications on climat; Extend electricity grid to rural areas;
5. Revise sectoral laws for proactive adaptation;
6. Create an early warning system for flooding and storms;

7. Early warning system (For extreme weather events-droughts, floods, storms and desertification);
8. National institutional mechanism for adaptation planning and mainstreaming;
9. Soil erosion control through organic methods;
10. Diversify crops to less climate sensitive cultures;
11. Technology needs assessment;
12. Variedades adaptadas as condições locais;
13. Climate monitoring and data management system;
14. Estudar as implicações de modificações da distribuição geográfica de doenças animais e de disponibilidade de água para a produção animal.

Climate change in Angola is expected to be visible through changes in the intensity and frequency of rainfall, changes in regional and temporal distribution of rains and seasons, variations in temperature and relative air humidity, temperature increase in some regions or decrease in others, prolonged droughts, intense floods, increase or decrease in the frequency and intensity of the winds, disruptions in marine currents and tidal activity and overall erratic climate variability.

One of the most visible incidences of climate change is its impact on water resources, and through these, on human well-being and on the main economic activities of the Country, such as agriculture, oil activity, maritime shipping and ports, fisheries, industry, rendering it vital that immediate adaptation measures considering the vulnerability of the area be implemented.

NAPA is one of the manifestations of the will of the Angolan Government to fulfil the international commitments related to the United Nations Framework Convention on Climate Change, particularly the impact of extreme weather events on the main sectors of socioeconomic development.

NAPA is the result of a participatory process with the different actors of the active life of the country and has permitted priority adaptation measures to be identified. The rapid implementation of those adaptation projects will contribute to minimise the adverse effects of climate change on the more vulnerable populations and fragile production systems.

The need to adapt is nowadays a fact and subsequently there should be human and technical capacity to resolve the problem and requires the intervention of all in order not to jeopardise the survival of future generations at risk.

Introduction

Climate change, despite it often being presented as a problem related to the environment, is in fact a challenge for socio-economic development. Vulnerability and adaptation deeply affect the Country's development model, especially the socio-economic sectors characterised as vulnerable. Histories of certain communities largely depend on their weather conditions.

Climate refers to the statistical pattern of different atmospheric elements, such as the temperature, humidity, atmospheric pressure, wind and rainfall which occur in a given region for long periods of time.

Climate change, due to the amplitude of the impact that it is expected to have on ecosystems and mankind, should timely appropriate measures not be taken in many sectors of activity, is still difficult to understand in Angolan society, when considering that questions of survival during the conflict did not allow the formation of an awareness geared towards environmental issues for most of the population.

The Angolan Government presents the National Climate Change Adaptation Programme of Action – NAPA, which follows the guidelines contained in decision 28/CP.7 of the United Nations Framework Convention on climate Change concerning the annotated guidelines for the establishment of National adaptation Programme of Actions in less developed countries.

National Climate Change Adaptation Programme of Actions emerge as an instrument aimed at meeting the immediate adaptation needs that less developed countries are facing.

The drafting of NAPA is of the responsibility of the Angolan Government and relies on the support of the United Nations Environment Programme (UNEP) and the Global Environment Fund (GEF). With this tool Angola makes an effective contribution in fighting the adverse effects of Global Climate Change,

GENERAL CHARACTERISATION

Geographic position, administrative division and natural conditions

Angola is located on the western coast of southern Africa, between parallels 4° 22' and 18° 02' South latitude and the meridians 11° 41' e 24° 05' longitude East of Greenwich, has a land surface of 1,246,700 Km², with a sea coast of 1,650 km and a land border of 4,837 km. The maximum length between north and south is 1,277 kilometres and the maximum width West East is 1,236 km. The Exclusive Economic Zone (EEZ) of Angola is also included, the sea area being defined by the lines corresponding to 200 nautical miles from its coast.

The Republic of Angola shares borders to the north with the Republic of Congo and with the Democratic Republic of Congo, to the east with the Democratic Republic of Congo and the Republic of Zambia, to the south with the Republic of Namibia and to the west with Atlantic Ocean.



Figure 1: Administrative Division of Angola
(source MINADERP)

Its political and administrative division covers close to 1671 towns and cities, 376 Communes, 163 Municipalities and 18 Provinces, i.e.: Cabinda, Zaire, Uíge, Luanda, Bengo, Cuanza-Norte, Malanje, Lunda-Norte, Lunda-Sul, Cuanza-Sul, Benguela, Huambo, Bié, Moxico, Namibe, Huíla, Cunene and Cuando-Cubango.

The climate is quite diversified resulting from a combination of factors, such as latitude (from 4 to 18 degrees), altitude (from 0 to 2,620 metres), orography, sea currents such as the Benguela Cold Current, river basin, such as that of the Zaire, Cuanza, Zambeze, Cunene, Cubango and other smaller rivers which flow directly into the Atlantic Ocean. Generally speaking, the climate is characterised by two more or less well-defined seasons:

- “Dry or Cacimbo”- cool from June to September;
- “Rainy” – humid and rainy from October to May.

The rainfall regime is much diversified, rainfall being almost daily in the North of the Country, almost non-existent in the South, mainly in the desert region. In the central plain the rainy season lasts almost eight months.

The relief is much differentiated, characterised by a coastline with an altitude of between 0 and 200 metres. The transition area has an altitude of between 200 and 1,000 metres and the plateau with an altitude of between 1,000 and 1,500 metres and which takes up most of the national territory. In the central region of the country which corresponds to the Provinces of Cuanza Sul, Benguela, Huambo and Huíla, between the transition area and the plateau, there is a marginal mountain range with an altitude of between 1,500 metres and over 2,500 metres, the highest point at 2,620 metres at Morro do Môco, Province of Huambo). With all this variety of factors, the average temperatures also vary greatly from one region to another, the north with 26°C and in the south lower than 19 °C.

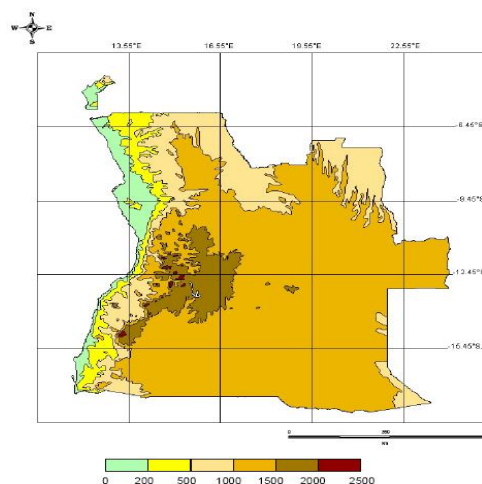


Figure 2: Relief of Angola (Source: REGA)

All the territory is part of an arid area but due to the variation of different geographical factors, such as the differences in latitudes between north and south which exceeds 13°, there are quite great differences in climate from one region to another. Other important factors which have an influence in this variation also include the differences in altitude and the proximity to or distance from the sea.

The main extreme weather events experienced to date are floods and drought. The climate consists of two seasons: the rainy season and the dry one.

The climate is divided into two differentiated climatic regions as is described below:

The Coastal region – relatively humid with an average rainfall of over 600 mm, the further south one goes the lighter it becomes.

The Inland region, which can be subdivided into three zones, i.e.:

- ❖ The *north* part with heavy rainfall and high temperatures;
- ❖ The *plateau* zone, characterised by average annual temperatures close to 18° C, with high minimum temperatures in the dry season; and
- ❖ The *southwest* zone is semi-arid due to its closeness to the Kalahari Desert with low temperatures in the hot season given the great continental tropical air masses as well as the influence of the Benguela cold water current.

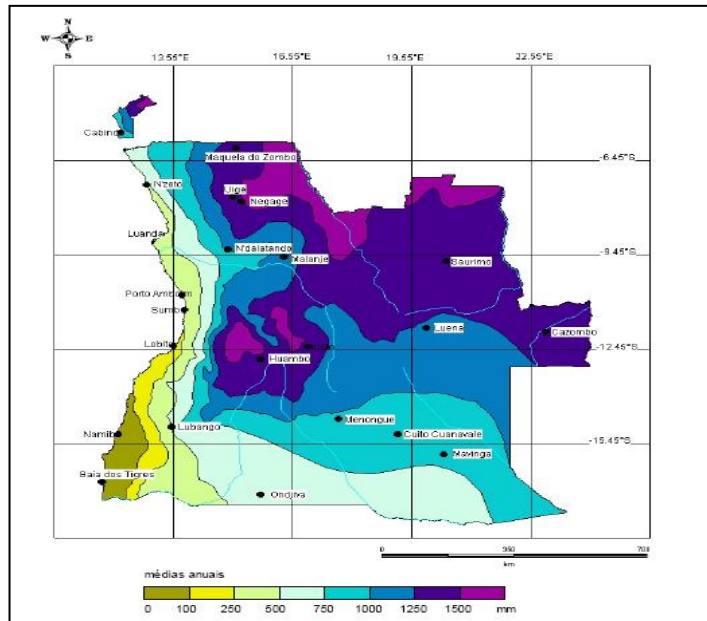


Figure 3: Average annual rainfall (source: REGA)

The province of Namibe in the far southwest of the coast influenced by the Benguela Cold Current and by the Kalahari Desert. Its climate is fairly arid with an average annual level of rainfall below 50 mm and the annual average temperatures between 18 to 20°C.

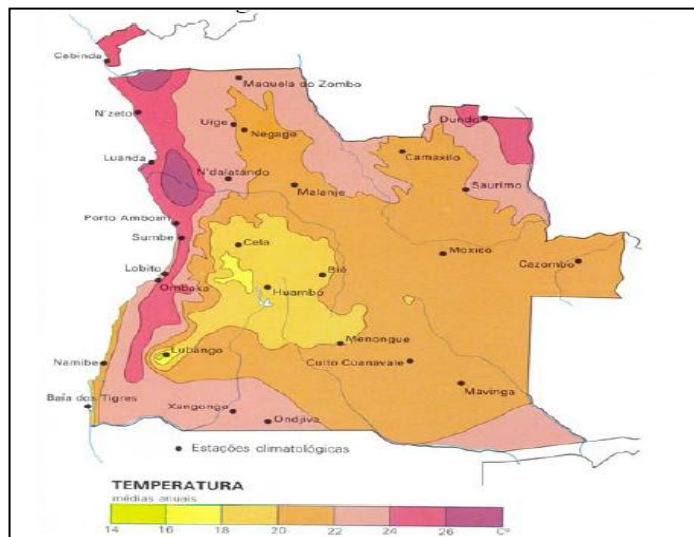


Figure 4: Average temperature

Population and ethno-linguistic groups

Angola is a multicultural and multilingual country. The population is estimated to more than 18,082,000 (INE 2010) inhabitants. Population density is close to 13.2 inhabitants per km², which is low when compared with the African average of 21 inhab/km². The Angolan population is very young. Approximately 50% of the population is under the age of 15, 60% under the age of 20 and 93% of the population is under the age of 50.

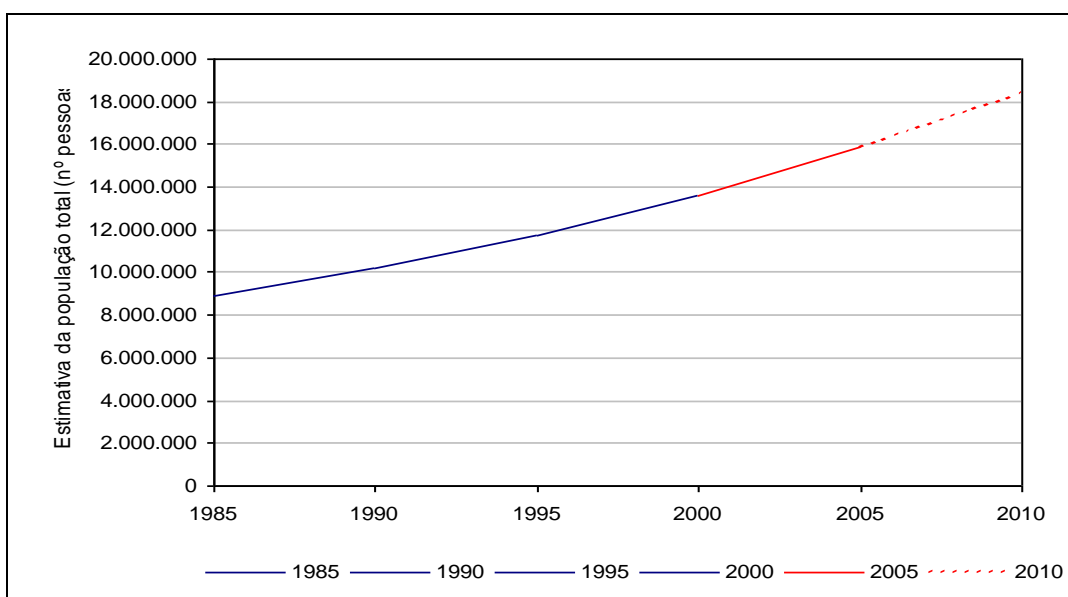


Figure 5: Projection of the Angolan population (source INE)

The war of independence, followed by the civil war that lasted until 2002, had profound repercussions on the demographic structure of the country, given that a large part of the population was forced to abandon their area of origin, with mass migration to urban areas. It is estimated that over half the Angolan population lives in urban centres, having brought with them their rural habits.

The average growth rate of the population is 3.5%. Life expectancy at birth is 46 years old, child mortality rate is 150 per thousand live births and child-adolescent mortality is of 250 deaths per thousand live births. The fertility rate is of 7.2 children per woman.

The Angolan population mostly consists of ethnic groups of Bantu origin: Ovimbundu, Ambundo or Akwambundo, Bakongo, Lunda, Ngangela (Ovankhumbi), Ovambo, Herero.

There is a small minority of non-Bantu native peoples, such as the Kung (Bushmen).

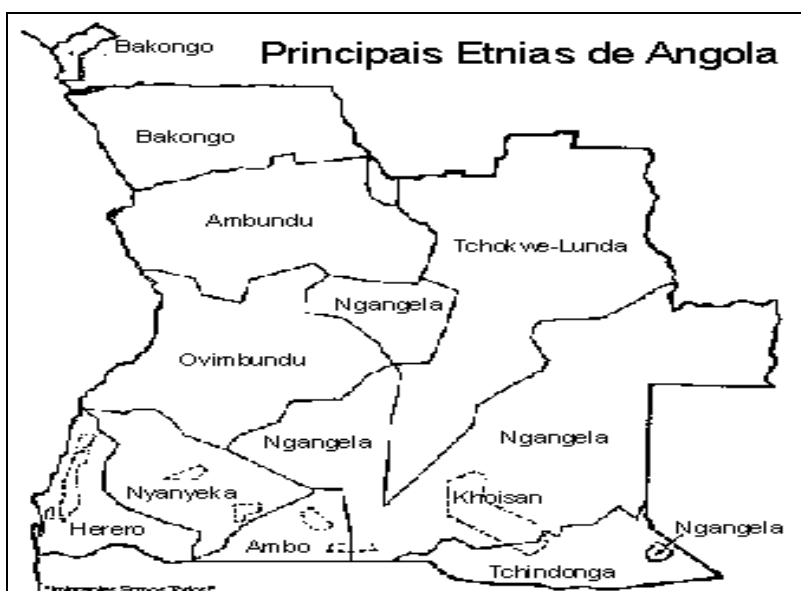


Figure 6: Main ethnic groups (Source: Lusotopia, 2006)

Most of the inhabitants have mixed origins, very frequently first from among different ethnic African groups who migrated to the territory and, subsequently, with the European population (mostly Portuguese) during five centuries of colonisation, thus resulting in a distribution of peoples as presented in the Figure 6.

Economic characterisation

The Angolan economy is characterised by high levels of growth but essentially dependent on the oil sector which represents 55% of the GDP and 95% of exports.

Despite its dependence on the oil sector, the country registers a remarkable macro-economic stability, which is reflected in the stability of the national currency, among other aspects. The non-oil sector, with potential to absorb a considerable part of the economically active population is undergoing a phase of reorganisation, reconstruction and rehabilitation.

The rural sector which includes farming, forestry and fisheries activities is the second largest productive sector in the country, the GDP of which is currently close to 8%, despite the existence of mines which are still an obstacle for the development of the rural environment.

Roads, railways and telecommunications and the food distribution industries and networks, destroyed during the conflict, are benefitting from reconstruction and rehabilitation works with large investments made by the State.

The income indices of the Angolan population are very low. There are obvious discrepancies in the distribution of national income, a consequence of the prolonged conflict, which the country recently experienced.

The level of poverty of the population is reflected in its poor access to food, drinking water, sanitation, education, health, electric energy and other commodities.

The dependence rate is estimated at 92.3 in every 100 people of a productive age of between 15 and 64, which translates into a high level of unemployment.

Table 1: Annual average sectoral growth rate

Sector of activity	2009	2010	2011
Agriculture	29.1	10.7	12.6
Fisheries and derivatives	1.52	2.8	7.8
Diamonds	3.6	-8.9	4.0
Oil	-3.6	3.4	6.1
Processing industry	9	20.0	15.0
Construction	12.3	10.0	12.0
Energy	10.9	21.2	20.0
Market services	-8.1	11.1	13.5
Others	3.0	9.6	10.0
GDP Factor prices	0.8	7.5	9.8
GDP Market prices	1.3	8.6	10.4

The macro-economic framework of Angola for the years 2010, 2011, is established in accordance with the forecasts for oil production and the expected behaviour of the price of crude on the international market, production of diamonds and expected price, variables relate to targets established for the inflation rate. The expected economic performance is positive, which is translated into a growth rate of the GDP at factor prices equal to 7.5% and 9.8% in 2010 and 2011 respectively. The greatest contribution for the projected economic growth comes from the sectors not associated with oil activities.

Table 2: Main socio-economic indicators of Angola

Name	2006	2007	2008	2009	2010
Surface in Km2	1,246,700				
Population (in millions)	16038	16526	17028	17547	18082
Population density (persons per Km2)	n-a	n-a	n-a	13,2	n-a
Demographic Growth Rate	3.5%	3.5%	3.5%	3.5%	3.5%

Population under 15	7,217	7,437	7,663	7,897	8,136
Urban population	50%	50%	50%	50%	50%
Rural population	50%	50%	50%	50%	50%
Overall GDP	18.6	23.3			
Forest area				43%	
Life expectancy at birth (years)	38.9	n-a	n-a	49	

In order to follow up the national reconstruction and economic and social development process, the Government has drawn up the “**Long Term Development Strategy 2025**” some of the objectives of which are as follows:

- Promote unity and national cohesion and consolidation of democracy and of its Institutions;
- Guarantee a high and sustainable rate of economic development, with macro-economic stability, transformation and diversification of economic structures;
- Improve the quality of life and human development of Angolans;
- Foster the development of the private sector and support national entrepreneurship;
- Strengthen the competitive integration of Angola in the international context;
- Implement a rural and peri-rural development policy which will mitigate the imbalance in the quality of life between urban and rural environments;
- Promote accelerated development with a view to replacing imports;
- Rehabilitate and develop the infrastructures required for the reconstruction and development of the country.
- Modernise the financial system and transform Angola into a strong regional and international financial centre.
- Define and implement an adequate social protection and national solidarity policy;
- Guarantee the rapid urbanisation of the musseques and modernisation of the urban communities.

Macroeconomic management and development priorities

In the post-conflict context, **social reintegration** of ex-combatants, displaced persons and refugees is a top priority strategic objective to guarantee the consolidation of peace and national unity and to promote local development.

Security and protection, clearance of mines and other explosive devices that are spread over the national territory are a fundamental condition to allow for the total freedom of movement of persons and goods in particular.

The **revitalisation of the rural economy** will help settle the population in the countryside and will progressively lead to a reduction in the dependence on agricultural products coming from abroad. The agricultural sector is one of the strategic areas of the future development of Angola, given its potential job creation and income generation for families and its vital importance to reduce commercial dependence and subsequently vulnerability of the internal market.

Education is one of the key elements of human development, increasing individuals' opportunities in society. Education is also essential for economic growth as it increases the quantity and quality of available human capital for the production process.

The **health** of the population is another key element in human development and is a necessary condition for economic growth. The main objectives in the area of health are those of guaranteeing the whole population with the provision of basic quality services, the main target groups being women and children. Pursuing efforts to prevent and fight the major endemic diseases with the greatest prevalence in Angola will be vital to guarantee a prosperous future from an economic and social viewpoint.

The development of basic **infrastructure** is also fundamental to ensure the basic living conditions for the whole population and to create basic conditions for the economic growth process. The improvement of the road network will allow for better access to markets and reduction of costs, and will facilitate communication and mobility, especially for populations who live in rural areas and who depend on agriculture. Water supply, sanitation and energy are essential for the development of human capital and for the increase in national production. The building of social housing will help settle and resettle families who live in precarious conditions in both rural and urban environments, thus providing them with the necessary conditions for a decent life.

Employment and vocational training play an essential role in the decrease of poverty ratios given that they directly contribute towards the livelihood of individuals and their families, and promote the enhancement of national human capital that is the basis of sustainable economic growth.

The quality of governance or **good governance** of State institutions is very important to guarantee the provision of public services for those most in need and to orient the economic and social development process, thus guaranteeing the fulfilment of norms and fundamental principles. The Fight against Poverty strategy includes a policy to promote good governance in its different forms, such as:

- The strengthening of the capacity and efficiency of the judicial system, thus protecting citizens' rights and freedom of citizens and enforcing compliance with contracts;

- The reform of public institutions to better respond to the needs of the population, by commencing with the simplification of bureaucratic procedures;
- Decentralisation and de-concentration of public administration to levels closer to the community; and
- The modernisation of public finance planning and management processes.

A stable macro-economic climate is essential to ensure investors' trust and to create good conditions for the increase of business activity and subsequent job creation and income generation of the population. Investments converge with greater fluidity towards economic contexts characterised by low inflation, stability of interest rates and exchange rates, transparent tax structures encouraging private initiative, efficient public management and judicial systems defending free initiative and private property.

Profile of the Main Economic Sectors

Angola is undergoing a phase of reconstruction and development. Now peace has been achieved, the Government is implementing its long-term development strategy. The objectives defined in the Angola strategy for 2000 to 2025 aim among, other things, to:

- Promote employment and enhance human resources;
- Build a more fair and equitable society;
- Guarantee the sustainable use of the environment, natural resources and to fight desertification; and
- Build competitiveness and develop the private sector.

In order to accomplish these objectives a number of preparatory actions were approved and are related to all areas of national life, priority in this initial phase being given to basic infrastructures, such as access roads, energy production, technical networks of human settlements, new human settlements, structuring of general, technical, vocational and higher education, structuring of the health, telecommunications and agriculture sectors.

Agriculture and fisheries

Angola has abundant natural resources essential for the development of its agriculture, with close to 57.4 million hectares of arable land, and only uses between 5-8 million hectares of this land.

Agriculture, before independence, was the main sector of the economy and the country was a great exporter of corn, cotton, sisal and most importantly coffee. Small-scale farmers especially in the central region were the main producers and were integrated in the market.

Most farmers practice traditional farming by using manual instruments to prepare and weed the soil, planting local seeds left over from the previous harvest. In the provinces of Huambo and Bié, on the coast of Benguela, and in the province of Huíla, many farmers use animal traction. Some of them use tractors to prepare and weed the soil, fertilisers and improved varieties of seeds. Land clearing and deforestation is still practiced in many areas as a means of expanding and preparing land under cultivation, as seen in the photo in Figure 7.



Figure 7: Area cleared before sowing

The national agricultural potential is high. The country has a capacity to be self-sufficient, to create surplus to export, as occurred in the first half of the 1970s with products, such as: corn, manioc, sorghum, rice, peanuts, sugar cane, sunflower, coffee, sisal, vegetables, citrus fruits and other tropical fruits, beef, pork and goat meat, milk and eggs.

Currently agriculture is predominantly a family-based subsistence activity for millions of small-scale farmers, who on average plant 1.4 hectares per family in two or more plots of land; the planted area increases slightly every year. Subsistence agricultural provides 85% of the rural population with their livelihood. Smallholder agriculture represents 90% of the total area under cultivation, while the remaining 10% is used for commercial agriculture.

For small-scale farmers and agricultural entrepreneurs, land represents the basis of their economic activity; security of tenure and use of that land influences the way it is used and

the level of investment. In 2004 the Government drew up the Land law, and in 2007 took an important step towards regulating land tenure. The agricultural sector is facing a number of serious problems, such as:

- Great scarcity of basic food products;
- Fragmented small-scale farms;
- Inefficient organisation of entrepreneurial-based holdings;
- Deficient and disorganised distribution circuits of farm and fisheries produce;
- Inadequate organisation of the fisheries sector and associated activities;
- Weakness of the economic and social infrastructures;
- Absence of rural extension structured services;
- Functional inability to control animal health.

The sector reveals a vital need to increase food production in competitive and lucrative conditions and to ensure its distribution, which presupposes that a number of requirements must be met, such as:

- Training of specialised staff in different areas of knowledge linked to the sector;
- Availability of production factors; infrastructures, access to water, adequate production technologies, organisation of rural markets, means of transport.

Fisheries are one of the main economic activities in Angola, contributing around 7.8% of GDP. In 2001, 20% of the catch (50 thousand tons) came from traditional fishing and 80% (190,000 tons) from semi-industrial and industrial fishing. The main catches are sardine, mackerel, marionga and lobster, followed by prawn, shrimp, crab, grouper, yellow fin, snapper, sea bream, etc. The resources of most industrial interest are prawn, mackerel, tuna and demersals. In recent years, there has been an increase in the industrial and semi-industrial effort in catching demersals, whose biomass is estimated at 87 thousand tons (INIP). In recent years, there have been oscillations in some groups of fish, specifically mackerel (INIP 2005). The biomass of crustaceans and molluscs is estimated at 3000T.



Figure 8: Fish landing site

The official statistics show that the contribution of traditional fishing increased, and now exceed 50% of the total recorded catch. Statistical data in 1974 estimated biomass reserves at around 700 thousand tons: today, the same reserves are estimated at around 200 thousand (DNP 2011).

Energy

Angola, due to its hydrographic characteristics, is the holder of a potential low-cost hydroelectric energy, evaluated at 18.000 Gwh which could be distributed throughout national territory to cover current and future needs and to export surplus to countries in the region.

The electric sector consists of three main independent systems rooted in hydroelectric power stations, namely, the north, centre and south isolated systems. The geographic division of the Provinces by systems is as follows:

- North System: Luanda, Bengo, K. Sul, K. Norte and Malange
- Central System: Benguela
- South system: Huíla and Namibe
- Isolated systems: Cabinda, Huambo, Bié, Zaire, Kuando Kubango, Cunene, Moxico, Lunda Norte, Lunda Sul and Uíge.

Table 3: Characterisation of current hydroelectric power stations (MINEA – 2007)

Systems	Power station	Installed power (MW)	Available power (MW)
NORTH	Capanda	$4 \times 130 = 520$	$2 \times 130 = 520$
	Cambambe	$4 \times 45 = 180$	$3 \times 45 = 135$
	Mabubas	$2 \times 3 + 2 \times 5.9 = 17.8$	0
CENTRE	Lomaum	$2 \times 10 + 1 \times 15 = 35$	0
	Biópio	$4 \times 3.6 = 14.4$	$2 \times 3.6 = 7.2$
SOUTH	Matala	$3 \times 13.6 = 40.8$	$2 \times 13.6 = 27.2$
LUNDA NORTE	Luachimo	$4 \times 2.1 = 8.4$	$2 \times 2.1 = 4.2$
TOTAL		816.4	693.6

However the sector has a number of problems that must be resolved, such as:

- Absence of a strategy and strategic policy which integrates all sources and forms of using energy;
- Installed capacity still short of its potential and the three main systems of electric energy production are not interconnected;
- Difficulties in the transport and distribution of electric energy;
- Losses and deviations of electric energy in terms of distribution (over 20%), only half of the energy supplied by the producer to the distributor being paid;
- Overall lack of human and technical resources in the sector;
- Almost total absence of the private sector in the production of electric energy.



Figure 9: Cambambe hydro electric power station

It is expected that the sector will play a key role in terms of increasing the productivity of the economy and ensuring that supply is compatible with demand vis-à-vis the economic growth and national development. For this purpose the objectives set out are the following:

- To rehabilitate, modernise and expand the electric energy production capacities and to pursue the institutional reorganisation of the electric sector;
- To promote the development of the national transport network, including the interconnection of the North/Centre and Centre/South systems;
- To promote the development of local sources, such as mini and micro-hydro power systems;
- To commence with the National Electrification Programme;
- To increase and diversify the production of electricity with the use of water, solar, wind and biomass sources;
- To guarantee a tariff system which will cover the costs of the operators and which protects vulnerable groups of the population;
- To ensure the correct management of the systems by systematising operations and maintenance;
- To promote the reform of the sector based on the Master Plan;
- To promote permanent training of staff for the sector.

Hydro-electric power stations are important for the production of energy. There are expectations of more power plants in the future (Lwauca and Caculo Cabassa). A greater variability of rains and the possibility of soil erosion and sedimentation have implications on the capacity of these power plants.

Water sector

Due to its geographical location, Angola is rich in water resources. According to the Water Sector Development Programme (Ministry of Energy and Water - MINEA, 2004), the annual run-off is estimated at 140 million m³ (140 km³). As to the potential availability of groundwater, according to FAO/Aquastat 1995 to the 140 km³/year of run-off 58 km³/year should be added, 95% of which directly feeds the rivers, whereas 5% flows into the sea.



Figure 10: River Kuanza

The origin of the main surface water resources is found in the plateau tops of Huambo, Bié and Moxico, a part running off into the Atlantic Ocean through the rivers Zaire, Kuanza and Kunene and the other into the Indian Ocean (rivers Zambeze, Kuando and Kubango). The river Kuando has its origin in Moxico and produces the third largest basin in Angola.

The rivers Zaire and Zambeze are two of the most important waterways on the African continent. These international rivers are located in areas where the rainfall level varies between 400 and 1,200 mm/year and its currents depend on more than 50% of the rainfall originated in the mountains upstream. The rivers Cunene and Kubango complete the set of international rivers of Angola. The river Kubango, with the tributary Kuito, creates the Okavango delta, which is of enormous ecological and economic importance for the region.

The groundwater resources are located in the coastal aquifers which have an average depth of between 5 to 30 metres, in the aquifers of the central plateau region whose average depth

varies between 10 and 30 metres, and in the aquifers of the semi-arid zones (Cunene) with depths of around 200 metres or more. The country also possesses several sources of mineral water.

The river basins considered as having potential for the development of agriculture and poultry farming are: Cunene, Kuanza, Cubango, Cavaco, Catumbela, Queve, Longa, Bengo, Bero Giraul, Curoca, Coporolo, Sumbe, Quicombo, Equimina, Cuvelai and Congo/Zaire.

One of the main problems related to water is the silting of rivers and dams as a result of soil erosion, which has strong impacts of the supply of drinking water and aquatic biological resources.

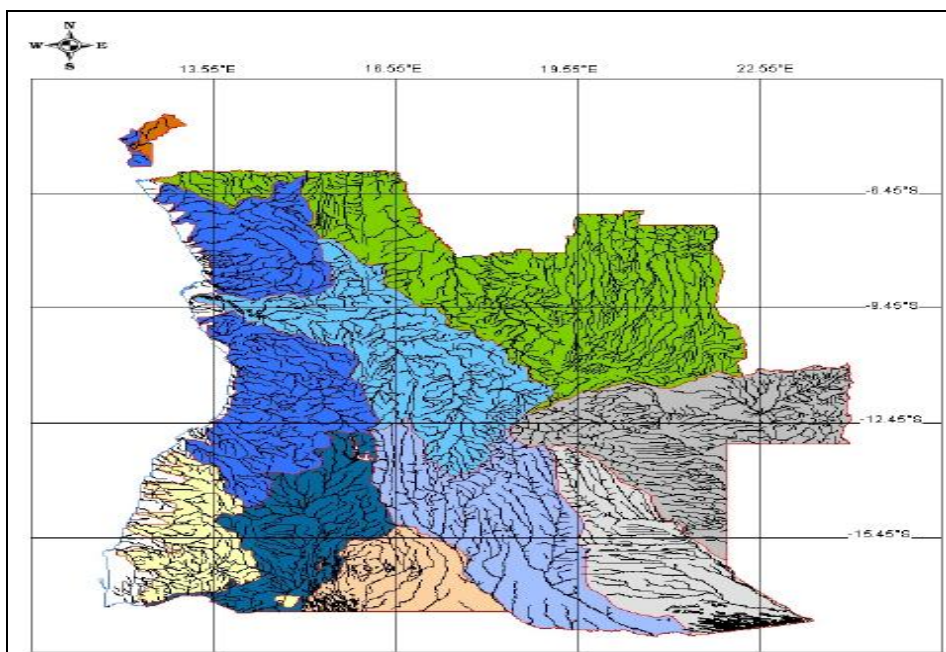


Figure 11: Angola’s Principal river basins (REGA 2006)

In Angola there are 47 river basins concentrated in 5 main areas. These are, Zaire representing 22% (green); Atlantic representing 41% (dark blue); Zambeze representing 18% (grey); Okavango representing 12% (blue – to the west of the Zambeze); and Etosha (pink - to the south).

Climate change can have significant impacts on the temporal and spatial distribution of the availability of water resources, on the quality of water and on the risk of floods or droughts. Together with these direct impacts, there are also indirect results resulting from socio-economic transformations and activities, which will worsen the pressures on the water environment by an increase in water demand or effluent pollution load to water masses.

Water resources are probably one of Angola's greatest assets, as the world moves towards a shortage of quality water for its populations, a result of the inadequate use of its reserves.

However the sector still faces a number of challenges, such as:

- Lack of information on national water resources;
- Saturation and waste in urban environments and poor distribution in rural environments;
- Sector's difficulty in controlling its use;
- Lack of specialised staff;
- Absence of norms regulating the Water Law and absence of a development strategy in the sector.

According to the UN, in 2006, 62% of urban population and 38% of rural populations had access to improved water sources. In rural areas, traditional boreholes still form the majority of water points, and many of them are in various states of disrepair. Water supply in many cases is also dependent on access to energy for pumping. The sanitation situation is a similar proportion, with 76% of urban population having access to sanitation and only 16% of rural populations in 2006. (UN MDG Database, 2006).

Education sector

The educational indicators of Angola are among the lowest in Sub-Saharan Africa. Recent statistical data describes the Angolan educational system as having a very low schooling rate, high rates of school drop-outs, high failure rates and low retention rates (students who remain in the system with success).

Access to education in the rural environment is of 25.1%, whereas in the urban environment it is of 40%. The school failure rate in the first three years of education is of 30-35%, and the average school drop-out rate is over 30%.

The illiteracy rate which has reached, according to the Multiple Indicator Cluster Survey of 2001, 33% of the population of over the age of 15, also an indicator of the low level of schooling. The illiteracy level is higher among women, reaching 50%. According to United Nations indicators, the illiteracy rate for the population over the age of 15 was in the year 2000 of 58%, in comparison with an average of 38% for all Sub-Saharan Africa.

The education sector is also faced with a number of constraints, despite the great effort made since independence. The great lack of teachers with appropriate training in basic education mainly in rural environments, the civil war which destroyed most of the existing school network and did not allow for regular education for many generations of students, particularly in the rural world, resulted in a part of the population at an active age without

the minimum knowledge to be able to learn trades and professions indispensable for the country.

Despite the huge effort made by the Government in the area of primary and secondary teacher training, most of the teachers do not take their professional obligations seriously, it being frequent to have teachers dropping out halfway through the school year, or being constantly absent, thus compromising the education and learning process of new generations.

According to the Angola 2025 report, the fundamental issues for the sector are:

- Low level of education of the population, low level of schooling and high level of illiteracy;
- Separation between education and training systems and between these and the development needs of the country;
- Need to interconnect the demand for access to education with the demand for knowledge, skills and qualifications;
- Articulation between different educational subsystems;
- Low level of income and efficiency with high levels of repeats and drop-outs.
- Therefore any policy to reduce greenhouse emissions will obligatorily be related to the level of knowledge of the Angolan population which must be gradually improved.
- The first educational level represents between 67% and 76 % of students and higher level with 3.2%.

Health sector

In the health sector, malaria continues to be the main cause of death in Angola, mainly in children under the age of 5. The anti-malarial treatment is not always available on the health network and, it is not standardised thus there is a great resource to self-medication with negative effects on subsequent resistance to medication. This disease is responsible for close to 35% of the demand for curative care and for 20% of maternal mortality, and also responsible for 40% of peri-natal deaths and 25% of maternal mortality.

Related to what has been said with regard to the education sector, the low level of schooling and knowledge of Angolans result in the health sector in:

- Low level of nutrition and access to good sanitation, water and energy conditions which result in a low health status;
- High maternal, child and child-adolescent mortality rate;
- Great incidence of infectious and parasitic diseases, such as malaria, increase in the prevalence of HIV/AIDS and a return of trypanosomiasis;

- Poor coverage of health infrastructures;
- Low per capita expenditure on health;
- Low level of human resources both in terms of quantity and technically speaking.

Related to lack of sanitation in rural areas, Angola also experiences high rates of water-borne diseases, including bacterial diarrhea, sleeping sickness, and other water-based ailments. Access to medical services is low, with physician density reported at 0.08 per 1000 inhabitants.

Housing sector



Figure 12: Sub-urban buildings

Housing must be the sector with the greatest number of problems in terms of meeting the needs of national citizens, given that from national independence to 2000, little was done to increase the national housing stock. The results of this are the current difficulties in the whole country of being able to buy or rent a residence, specially a disturbing problem for the youth.

The main problems are:

- Absence of a global and integrated “Habitat” policy;
- Low quality and over occupation of homes at the peri-urban and urban level and even rural, with severe deterioration of urban buildings;

- Poor access to basic sanitation, water and electric energy in both quantitative and qualitative terms in the urban and rural environment;
- Low number of cities with coverage, even partial coverage, of waste water drainage networks;
- Housing shortage of over one million units.

With the advent of peace and ongoing national reconstruction process since that date, in 2008 the Government launched a construction programme of a million dwellings all over the country, especially in the provinces with greater problems in terms of lack of technical staff as a way to encourage recently trained youngsters in these regions and areas where there are greater housing problems.

Telecommunications and information technology sector

The strategy defined for the sector aims to ensure the expansion diversified information and communication support infrastructures of good quality which should be available to society as a whole in all regions of the Country.

In the area of meteorology and geophysics the pursuit of adequacy to the provision of public services sector is pursued, emphasising the operational aspects, cost-effectiveness of infrastructures and information networks, in articulation with research and development;

Environment sector

The environmental dimension of development increasingly claims for greater attention to be given to the promotion of sustainable development. In effect, during the implementation of the National Environmental Management Plan, the objectives to be accomplished are the following:

- To develop a National Waste Strategy;
- To take stock of and manage national wetlands;
- To rehabilitate in phases Parks and Natural Reserves;
- To develop a National Environmental Indicators Control System;
- To develop the implementation process of the National Climate Change Programme

3 million acres of land are considered to be forests (43,3% of the country's territory). Only 2% is comprised of dense, humid, high productivity forests, very rich in biodiversity. 65,2% is comprised of a mosaic of forest and savannah, as well as open forests called miombo, with medium productivity of wood, but socially and economically important for the production of wood fuel, construction materials, medicinal plants, and non-wood

products for food. The remaining percentage is occupied by dry savannah, with sparse trees and/or bushes, desert and sub-desert steppe of low productivity. The wood chopping capability in the country's natural forests is of 333.000 m³ per year, which can allow the transformation of 1,150m³/day of chopped wood.

Angola faces a number of environmental challenges, chief among them soil erosion, land degradation and desertification. This is due to a number of factors, including inappropriate land cultivation practices, deforestation (for energy and commercial timber, including in the rainforests), as well as climate-induced erosion (severe rainfall).

Angola is home to a number of Endangered species in Angola include the black-faced impala, three species of turtle (green, olive ridley, and leatherback), the giant sable antelope, the African slender-snouted crocodile, the African elephant, Vernay's climbing monkey, and the black rhinoceros.

The coastal zone

Approximately 50% of Angolan population resides along the coastal zone. The Angolan coast is generally shallow between Cabinda and Benguela and deep between Benguela and Foz do Cunene. There are some inlets along the coast, such as the Bay of Malembo, in Cabinda, the Dande Sandbar in Bengo, the Bay of Luanda, protected by the Island of Luanda and the Bar of Corimba protected by the islands of Mussulo and Cazanga.

Most of the cities along the coast face problems from overloaded water, power and drainage systems, due to buildings being occupied by a higher number of people than planned. Collection of solid waste in urbanised zones is deficient: in outlying areas it is practically non-existent. Given the scarcity of land in good areas, there is widespread land speculation, high density of constructions and occupation of at-risk zones (areas susceptible to landslides, floods and other natural catastrophes). Unauthorised occupation of land in cities, changing buildings and paving using construction materials with high levels of rainwater absorption and solar ray reflection have contributed negatively to the low environmental comfort in the cities' micro-climates.

These cities are also where infrastructure insufficiencies are dealt with by improvised measures, such as latrines discharging into the open and distribution of water by unlicensed agents using methods that are not appropriate for water transport and storage, increasing the risk of contracting infectious diseases.

The main ports along the Angolan coast are generally protected by sandbars, formed by the sand deposited by Cuanza (Luanda), Catumbela (Lobito), and Cunene (Baía dos Tigres) rivers. The coastal strip also contains the country's major economic objectives such as

airports, oil activity that extends into the exclusive economic zone, most industries, hotel investments and other infrastructure.

CLIMATE CHANGE IN ANGOLA

The use of climate models is relatively new in Africa. Few scenarios have been developed due to the poor capacity of computers and human resources (IPCC, 2007). Some climate models have been made for regions of Africa to the south and east of Angola, but almost no work has been done for Angola and mainly for the north region, the main reason being the lack of available meteorological data on Angola. Since 1901 efforts have been made to increase the observation network. In 1950 this network was extended with the creation of a dense network of weather stations on the western part of Angola and some coverage in the east. This network is comprised of three levels of stations:

- Rain gauge posts which gather basic information;
- Weather posts which gather information of an intermediate level, and
- Meteorological stations which collect a full range of meteorological data; this network lasted till 1975, and the 1972 map shows the real coverage existing between 1950 and 1975.

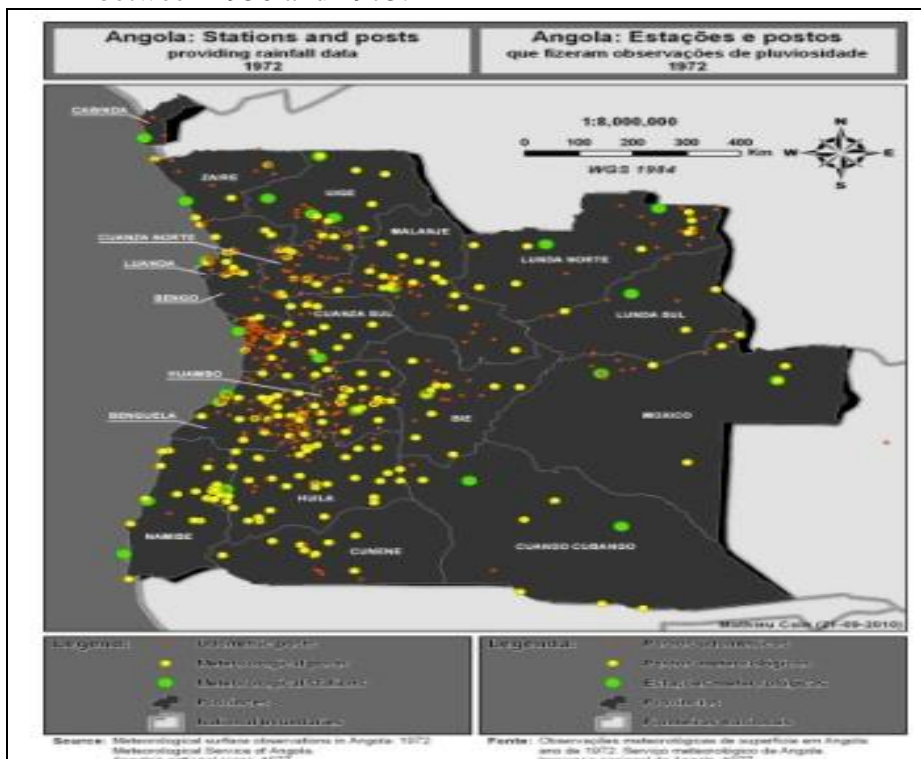


Figure 13: Hydrometric stations in 1972

In 1975, with the collapse of the Portuguese colonial regime and with the departure of the Portuguese colonists, the number of sites to collect data on rain dropped from over 500 to

20. Several attempts were made to increase the number of stations but were foiled by the civil war. In the 1990s the United Nations, as part of their peacekeeping efforts, supplied material to restart the collection of some meteorological data, but this was destroyed by fighting in late 1990. In 1997 there were only eight stations in operation and in 2007 there were only eleven. The data from any individual stations tends to have shortcomings.

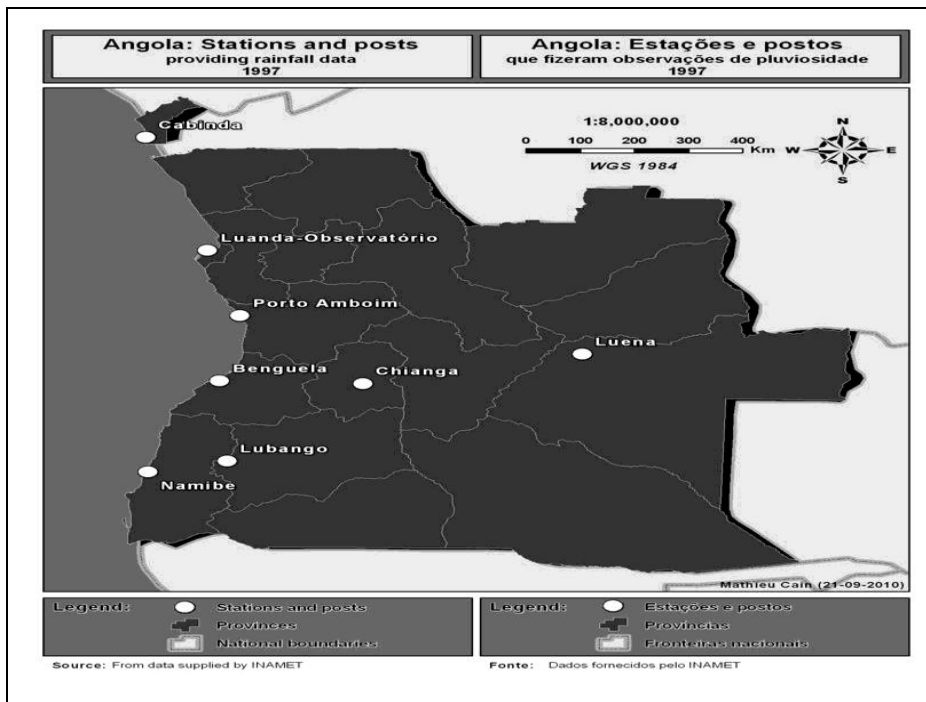


Figure 14: Hydrometric stations in 1997

The low level meteorological data coverage renders climate modelling difficult. This is particularly important in a country with a very diverse climate, where the climate changes rapidly and in a short distance in some areas and where there is high level of variability from one year to the next.

There are shortcomings in the understanding of climate systems in inter-tropical and subtropical areas and a limited understanding of the complex interaction of the principal physical processes that govern the response to the regional climate, as well as to global processes. The impact of Benguela Cold Current on the coast of Angola is manifested by desert conditions on Skeleton Coast - Namibe, semi-arid areas south of Benguela, and persistent fogs along Angola’s southern coast.

According to a UNDP report (2008), there has been an increase in temperature in the area where Angolan territory is located of around 1.5 ° C were 0.33°C per decade in the surface temperature between 1960 and 2006. There has been a greater increase in the dry or

cacimbo season of 0.47°C than in the hot season of 0.22°C per decade. Daily observations of temperatures show significant increases in trends of hottest days in every season, as well as every night with the exception of the months of December, January and February. The main trends for the rise in temperature according to the Global Climate Model refer to 2060 with increases of 1.2 to 3.2°C and 2090 with increases of around 1.7 to 5.1°C. and the period until 2030 was not calculated due to lack of data. The annual projections also indicate for Angola a rise in temperature of between 20-40% until 2060 and 25-65% until 2090. During the period 1960 and 2006, there was a drop in annual rainfall of close to 2 mm a month (2.4%) mainly in the months of March, April and May and a decrease of 5 mm a month (5.4%) per decade.

Climate variability

A preliminary model for Angola, using estimates of rainfall from the extrapolation of existing data (National Centre for Atmospheric Research), indicates that in Angola in the future the average rainfall will be similar to current rainfall but there will be greater variability and greater periods of intense rains (Dr. Mark Jury, personal presentation). This does not mean that in certain regions rainfall will not drop (for example in the south) and rise in others. The Luanda observatory has had annual rainfall data from 1901 to the present day and the Chianga Agronomic station has had consecutive annual records since 1943. Other stations produced data up to 1975 and the few that continued have long time gaps in their data.

In the case of Luanda there is a great deal of variability in the rainfall from one year to another. In 30% of the year's annual rainfall is low by over 30% of the average and in 24% of the years the annual rainfall is 30% higher than the average calculated at 347 mm.

The rainiest months are March and April when the inhibitor effect of the Benguela Cold Current is weaker but variability in these months is high: rainfall varies between zero and 400 mm in those months. Normally rainfall in those months comes in the shape of torrential rain.

There was a rising trend of rainfall between 1941 and 1964 and later a rapid drop between 1964 and 1978. After 1978 the rainfall rose to the levels of 1941. There are no reliable indications of future trends but the variability and torrential rain in certain years has serious implications. In Luanda there is a high variability and trend for torrential rain in certain years.

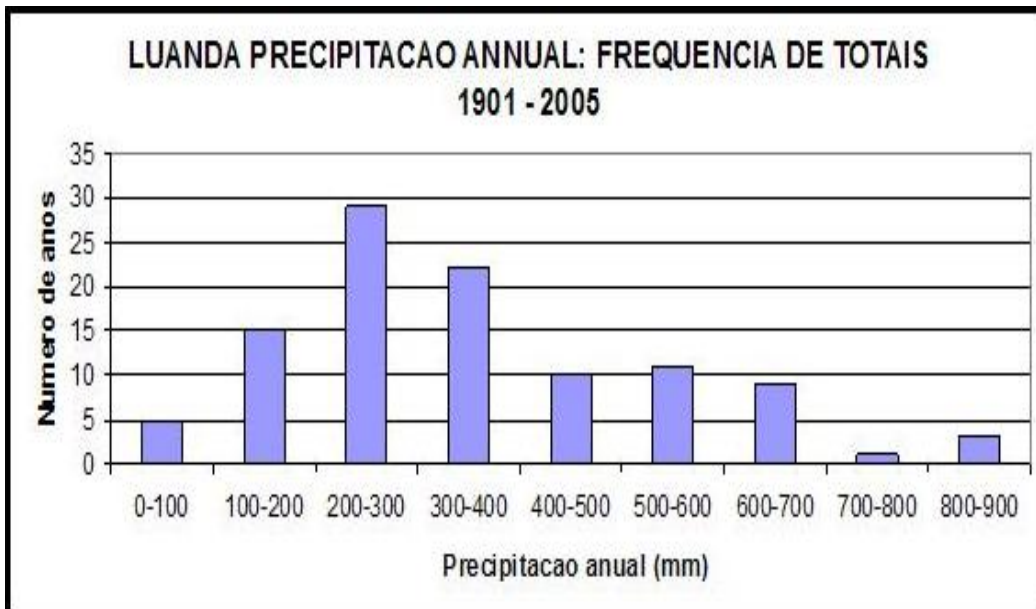


Figure 15: Annual rainfall in Luanda

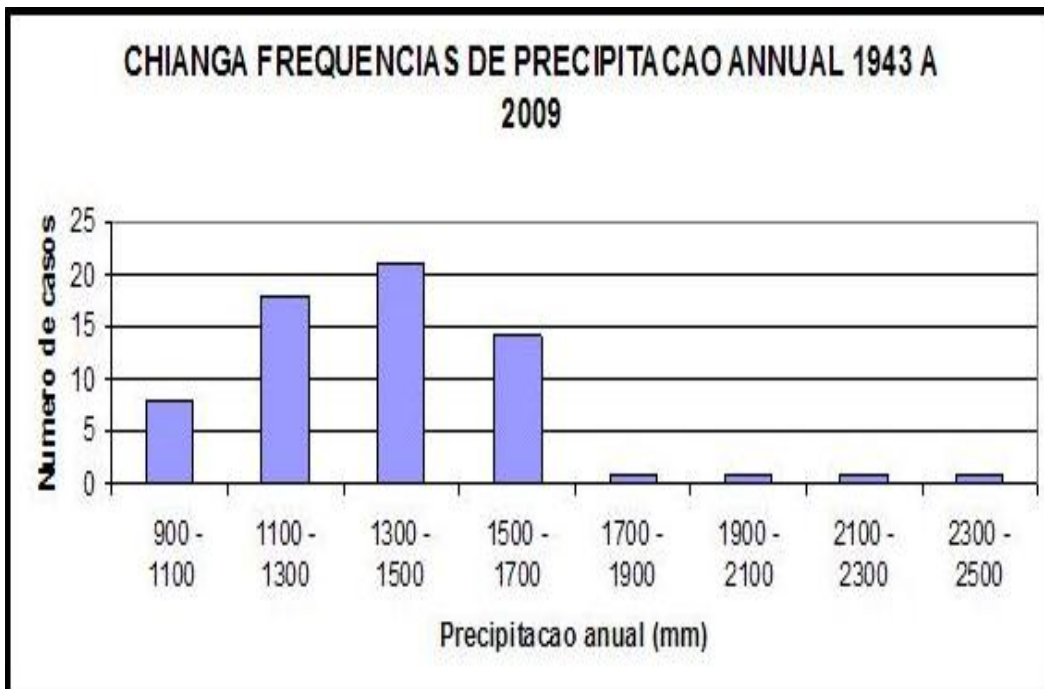


Figure 16: Annual Rainfall in Chianga

In the Chianga Station, close to the city of Huambo, the average annual rainfall is of 1.389 mm a year. There is no long term visible variation trend in the records of rainfall. Inter-

annual variability is low in comparison with other parts of Angola: only one year in 65 years of records shows an annual total of 30% below the average. On the Central Plateau rainfall is always high and with little variability, the exception being of drought in certain years, but there are years that the rural communities call dry years, which are years in which there is a dry spell of over 20 days in the middle of the rainy season (which has significant implications for agricultural production).

Discussions with the rural communities confirmed that rains are high every year, and that no long term trend has been noted for rains. When one talks of dry years, the rural population in this region talks of years in which there is a period of two weeks or more, during the rainy season, with low rainfalls. The years in which this has happened since 1950 are the following:

- 1954/1955 First two weeks of February 1955;
- 1971/1972 February 1972;
- 1973/1974 20 January until 10 February 1974;
- 1977/1978 20 January until 20 February 1978;
- 1985/1986 20 December until 10 January 1986;
- 1988/1989 20 February until 10 March 1989;
- 1994/1995 10 till 30 of January 1995.

The rural communities were able to indicate the year in which this happened starting in 1954/1955 and the information was consistent among all communities and the meteorological data of Chianga. There are also associations with certain migratory movements of animals and birds. These are used to predict rainfall and to inform on options on varieties and types of crops.

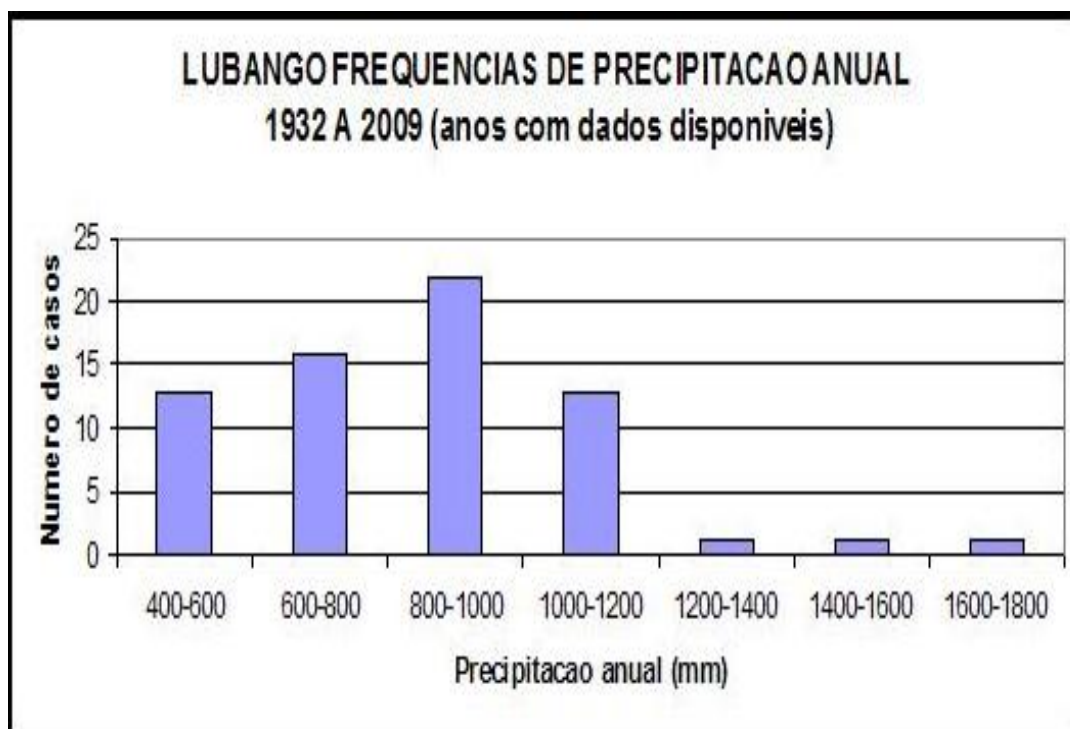


Figure 17: Annual rainfall in Lubango

In the region of Lubango ($14^{\circ} 56$ S, $13^{\circ} 34$ E) droughts are less significant than in further north. However, total rainfall is less than in the central plateau and it is common for farmers to grow short-cycle corn which is harvested in the interval of rains and when the land is ready to be sown again.

It is therefore a climate with significant differences. For example, the rainfall varies between 10 mm in Tômbwa (Province of Namibe) to close to 1700 mm in the north. The rainy season lasts for over 8 months in the north of the country and lasts less than 4 months in the extreme south.

Rainfall increases as one moves from the coast inland and from the south to the north. In certain areas, for example, between the Ocean and the west interior, the climate changes significantly over a short distance. Therefore, manifestations of climate change and its impacts will probably differ in different parts of the territory.

The climatic models of the region of Southern Africa do not include Angola and the DRC due to lack of data but some models have included areas bordering with Angola. (Shongwe et al, 2009. KNMI, 2006) There is a high degree of consensus between the models as to the climate in Namibia which may be drier in the future. In the north of Botswana and in the

south of Zambia the models indicate a descending trend in the rainfall level in the 21st century and expect that rains will begin later.

The base of the models of neighbouring countries reveals certain indications that the east and northeast of Angola may have higher rainfall in the future and more events of intense rain.

The El Niño Oscillation is a meteorological phenomenon in the Pacific Ocean that is accompanied by movements of air masses at a global level. Analyses of the historic data for the world's climate for the last 100 years indicate that El Niño is linked to the weather in various parts of the world.

To produce the forecast for the climate in Angola, the interaction of the ocean - atmosphere system and its implications for the climate of the Southern African region has to be taken into consideration. One of the main factors considered is the current state of the El Niño phenomenon and the surface temperature of the ocean (INAMET, 2010).

There are other factors that contribute to climatic variability in Angola. These factors have not yet been the object of in-depth studies, unlike El Niño. The forecasts for climate change in Angola have to take into account not only El Niño but also the need for an in-depth study of the factors that contribute to climatic variability. Climatic variability in Angola depends above all on conditions in the Atlantic Ocean, although the humid winds that bring rain to Angola generally come from the Indian Ocean. El Niño influences the conditions in the Atlantic Ocean, and so also influences the meteorological conditions in Angola.

In the area of hydrology, there is scarce information about the operation of fluvial basins, but actions need to be taken to improve knowledge in this area. If there is an increase in normal temperatures, there will be more evaporation, which could reduce flows in rivers and also reduce rainfall in certain areas.

The variability of precipitation, or its distribution into more intense rains, implies a change to the parameters of the fluvial basins (sedimentation or the probability of floods). More soil erosion could have implications for sedimentation in fluvial basins. Modifications to hydrology also have an effect on neighbouring countries that contain the final stretches of rivers that rise Angola.

The maritime coastal currents (the Benguela Cold Current and the Gulf of Guinea current) are part of the system that redistributes energy at a global level, and may change due to climate change. Another factor along the coast is the rise in sea level. There may also be modifications in coastal sedimentation and erosion if there are changes in the hydrography of rivers that discharge into the Atlantic Ocean. There are implications for oil installations, ports, human settlements and other installations along the maritime coast.

Impacts and Vulnerability

Within the limits of available knowledge and understanding of Angola's climate variability and patterns, it is possible to determine possible impacts on overall climate parameters for the country, which themselves are anticipated to have significant social, economic and environmental impacts.

For example, it is reasonable to expect that modifications to the Benguela Cold Current may have implications for coastal fishing, communities and the fishing industry. Changes to river hydrography, flow rates, or water temperature may have implications for river and lake fisheries, as well as coastal ecosystems.

Increases in temperatures will have an impact on crop growth, soil moisture retention and disease tolerance as well as on pest control. Changes in precipitation and hydrology affect rainfed and irrigated agriculture in all areas of the country, and increased rainfall variability (temporal distribution as well as absolute amounts) will have an impact on crops. The amplitude of impacts will depend on the area of the country, the agricultural systems in each region and the current vulnerabilities.

In terms of human settlements, higher temperatures imply a need for greater cooling of inhabited and occupied spaces, which will have implications for the design and orientation of housing and other buildings as well as energy consumption. The design of human settlements must also take into account the risk of flooding and the need to reduce the risks of soil erosion. Coastal infrastructure, settlements, road networks and port authorities will also likely be impacted by increased floods, and sea level rise.

The impacts of war and prevalent low soil fertility are further factors that reduce the capacity to manage the risks created by the climate in these areas. Further south there are signs of a reduction in precipitation and of an increase in the variability of precipitation. Pre-existing, non-climate structural constraints in the country further reduce local and national capacity to adapt to these anticipated impacts.

Extreme events: Floods, droughts and soil erosion

Recently, floods have been an important phenomenon in Angola. The Bay of Cuanhama and the city of Ondjiva have been most affected in the past 10 years. The city of Luanda has been affected since 2007 and the cities of Benguela and Namibe have suffered floods in some years that have generally resulted in flooded houses and commercial buildings and in transport disruption for lengthy periods, in part due to the growth in cities in at-risk zones.



Figure 18: Floods in the Cuvelai Basin (2009)

In some rural zones the inhabitants choose to live on the banks of the rivers because they want to live close to fertile soils to cultivate their food, and be close to watercourses for fishing; they know it is dangerous to live close to the river and they could lose their belongings in floods, and there is an increase in waterborne disease, but their way of life is vulnerable. Inhabitants along the banks of the Zambezi River and the rivers in the province of Kunene report that in recent years floods have been more frequent. Some communities judge that they can calculate when they need to abandon flood zones, but at present the traditional cycles of rain and drought are not predictable, and the existing warning systems used by the communities are not sufficient to protect those who live in at-risk zones.

The surveys carried out by the Red Cross in region of the Zambezi have found that floods, the subsequent dislocation of people, and the loss of crops, have caused extreme social, economic and psychological vulnerabilities, as well as in the area of health. These vulnerabilities are due to a series of factors, including the lack of drinking water and sanitation infrastructure, the existence of stagnant water, which increases waterborne diseases such as cholera and higher reproduction among mosquitoes, causing more malaria and an almost exclusive dependency on corn production, low sources of income, higher food insecurity, a higher number of family units headed by women, and even an invasion of crocodiles and hippopotamus due to high water levels.

Soil erosion, which is a problem in most areas, may be aggravated, or accelerated by more intense rains. Greater soil erosion has implications for sedimentation in the fluvial basins, as well as for agriculture, infrastructure and industry. More severe rainfall events could cause massive landslides in poorly constructed urban areas, or along denuded or deforested slopes.



Figure 19: An example of landslide or sinkholes in a sub-urban area

Vegetation and organic material protect the surface of the soil in its natural condition in the rainy season. The roots bind the soil. The vegetation and its roots are factors that inhibit the movement of water on the surface, thereby reducing the speed of surface run off. Where there is human activity, there is a trend for soils with a low level of organic matter. Where the surfaces are bare and rain cannot soak into the soil, water starts to flow over the surface.

Most Angolan cities have at-risk zones or signs of erosion in their districts. While erosion is more of an urban problem in Angola, in other African countries it is a rural problem. In Luanda, for example, the city has and has always had inhabited areas on the cliffs along the coast. The city of Huambo is on a plateau but there are a series of important rivers that rise near it. The Province of Kunene and particularly the city of Ondjiva have suffered flooding in recent years due to the rivers in the Cuvelai basin breaking their banks after anomalous rainfall.

The risks from erosion do not depend solely on natural factors. Soil use in at-risk zones and the extraction of minerals, wood and timber are human activities that leave the ground without protection or vegetation cover and are common activities in Angola.

Impacts on agriculture and fisheries

Agriculture

Angola has a varied climate and consequently its agricultural systems are adapted to diverse conditions. Agricultural systems were studied in the 1970s: after that, conditions changed due to rural depopulation during the war and the dispossession of farmers and labourers. There is insufficient information about the critical points in the agricultural systems and how they could be affected by changes in normal temperature and precipitation.

There is information from other areas in Africa that farmers have already felt the impact of climate change on production. The nature of the impacts varies widely between the regions of the continent (Dinar et al, 2009). The increase in temperature has a negative impact on agricultural production via an increase in evaporation and transpiration. If evaporation increases significantly it may result in falls in soil humidity before the main farming season starts, depending on changes in rainfall. The changes in precipitation and hydrology affect dry and irrigated agriculture.

According to the IPCC 2007 Report, some countries in Africa will see their potential rain-fed agriculture reduced by 50% by 2020, as a consequence of climate change, with severe repercussions on food security and their populations' nutrition. The report also estimates that sub-Saharan Africa will see falls in production with falls of between 2 to 7% of GDP, making these countries more vulnerable.

The analysis made for this report into the Central Plateau indicates no trend to a rise or fall in precipitation, but years with a prolonged dry period during the rainy seasons have an effect on crops, and yields have been steadily decreasing throughout the country. A combination of increased average aridity with severe rainfall events and increased average temperatures could lead to severe impacts on smallholder agricultural producers who lack the technical means to adapt to changing production conditions.

In the Huíla highlands and in the centre-south transition area, there are signs of both a fall in precipitation and an increase in its variability. These zones were less affected by the war and by low soil fertility, but there are signs of an impact from climate change (reduction in crops, loss of productivity by variety and surface unit).

The distribution of animal diseases depends to a certain extent on temperature and humidity. The north of Angola is a tsetse fly zone. Control measures to limit the epidemic expanding beyond this area have been implemented since 2002. A change in temperature could create a risk of this area expanding.

Fisheries

Regarding climate change impacts on fisheries, the most probable effect of climate change on the system north of Benguela is an alteration in the frequency and amplitude of tropical intrusion, modifications in wind currents, changes to wind stresses and in the intensity of coastal seepage and the gradual rise in sea surface temperature as well as sea level.

The oceans' productivity is already in doubt due to an increase in sea temperature and over-fishing and the modifications to the Benguela Cold Current could have implications for coastal fishing, communities and the fishing industry. Modifications to river hydrology or water temperature may have implications for river fishing. Climate change has the potential to influence the geographic location, the diversity of species and the functionality of ecosystems, which can occur so quickly that the ecosystems are not able to adapt.

Infiltration by salt water as a result of reduced outflows from rivers and an increase in sea levels may affect agricultural land along rivers close to estuaries. The variability of precipitation creates a greater risk of agricultural land alongside rivers being flooded.

The preliminary analysis indicates that the risk to agricultural activities due to climate change is highest in the south and south-eastern zones of Angola. They contain areas that are already marginal for certain agricultural activities where water availability is a critical factor and where variability is already high.

Impacts on human settlements and infrastructure

Climate models indicate that there has been an increase of around 3.0°C in the surface temperature over the last 100 years. The phenomenon of high urban temperatures is called a "heat island", which causes discomfort in cities with a hot tropical climate.

Temperatures in urban zones are much higher than those in rural zones due to the concentration of anthropic heat sources and higher heat absorption. Urban surfaces have greater reflectivity than rural ones. The use of materials that are highly absorbent of solar radiation (low reflectivity) causes more heat to build up throughout the day. The deep spaces between buildings (urban canyons) impede ventilation and cooling for the surfaces.



Figure 20: peripheral semi-urban settlements

Changes in air humidity, precipitation and wind are also associated with heat islands. It is in urban areas that the effects of higher temperatures may be felt. In cities at sub-tropical and tropical latitudes, due to the high intensity of solar radiation, urban heat islands occur during the day, aggravating the sensation and discomfort and reducing the relative air humidity. Prolonged stays in hot buildings have a negative effect on a person's general state of health, due to the extreme demands made on his or her heat regulation mechanism. Air conditioners or fans may compensate for higher temperature, but they are expensive for certain groups of the population and use significant amounts of electricity. During heat waves, energy peaks are created to cope with refrigeration and cooling and the increase in peaks will probably be higher than the average increase in energy use.

Higher temperatures and severe rainfall events may increase the degradation of construction materials and structures, including energy installations located in the coast or along river banks that tend to overflow, road networks and transportation systems. The impact of heat will include more frequent expansion of railways tracks and cracking of asphalt and other materials may be damaged more easily.

The variability in precipitation could cause an alteration to the flow in rivers. If bridges and other evacuation routes for excess water are planned without taking into account an increase in rivers' maximum flows, their capacity may not be sufficient to drain large

volumes of water, resulting in floods in river areas (as has been the case in the Province of Kunene in recent years).

Impacts on human health

The state of health of the Angolan population is characterised by low life expectancy at birth, high rates of maternal and infant mortality, high rates of transmittable diseases and a rapid increase in sickness and mortality rates for chronic and degenerative diseases, as well as premature, preventable death (National Health Policy, April 2010). The systems for environmental surveillance and sanitation still have weaknesses and are not all-encompassing throughout all priority areas, nor at all levels.

Malaria continues to be the primary cause of sickness and mortality, representing more than 50% of admissions in the country's health units. In the year 2005, there were 2,329,136 notified cases and in 2009 there were 3,726,606, with a mortality rate of 0.3%. This disease is responsible for 23% of deaths in children under the age of five, and also contributes to maternal mortality (Annual Epidemiological Bulletin - DNSP 2009).



Figure 21: Effluent discharge in urban areas

The presence of the malarial mosquito depends on the temperature, humidity, water and wind. The malarial mosquito swarms in sufficient numbers to transmit the disease in regions where the average temperatures are around 20-30 °C, and humidity is high. The effect of climate change on the distribution of malaria is controversial. Other factors may have changed the distribution, for example, resistance to drugs and changes in insect control. There is a chance that malaria may spread to areas in Africa where it is rare for climatic regions. Higher temperatures may extend the amplitude and prolong the season for transmitting diseases caused by insects, especially malaria. At present, in locations of altitudes of 1500 metres or more the risk of contracting malaria is low, but certain zones of this type in Africa may have a hotter and more humid climate in the future with a higher risk of malaria.

According to the IPCC 2007 Report, the results of mapping malaria in Africa shows the possibility of expansion and contraction depending on the climatic location of the areas affected by malaria between the years 2020-2050. (Thomas et al, 2004). Between 2050 and 2080, the western part of the Sahel and Southern Africa may show a reduction in cases of malaria, but during this period the higher parts of Somalia and Angola with few cases of malaria may see an expansion of the disease.

In regard to Chagas disease, there has been a decreasing trend in cases, with 1,727 detected in 2005 and 295 in 2009 (ICCT, 2010). The people who are most exposed to the tsetse fly, and therefore the disease, are, in rural populations, dependent on agriculture, fishing, livestock and hunting. The geographic distribution of Chagas disease is limited and may change along with climate change. However, the most important factor that influences the frequency of Chagas disease is the effectiveness of the anti-insect struggle. In Africa, the rise in the number of cases after the 1960s was due to the reduction in control measures

The increase in temperatures and more humid conditions could have an impact on human health via a change in the geographic distribution of diseases. All diseases transmitted by insects are sensitive to climatic factors.

Meningitis is an inflammation of the membranes around the encephala and the spinal medulla, known collectively as meninges. The inflammation may be caused by a virus, bacteria or other microorganisms and generally occurs in the dry season and can last for two to three years. IPCC projections of an increase of 5-8% in arid and semi-arid land in Africa may increase transmission and encourage expansion of the meningitis zone.

In Luanda, with intense rain and floods in 2008, there was an increase in diseases associated with contaminated water (cholera, gastrointestinal diseases and malaria). One of the consequences of climate change could be an increase in the number of extreme events that generally cause a peak in the incidence of diseases associated with a decline in

personal hygiene, as well as a lack of drinking water. High temperatures and humid conditions even for short periods can have an effect on the quality of food.

More frequent floods may create risks of diseases connected with deficient sanitation. Variability in rainfall or more intense rains, which imply changes to the parameters of the river basins and floods, soil erosion and sedimentation, will have implications for infrastructure and transport which may be damaged by abnormal flooding.

Impacts on the Coastal zone

Around 50% of the Angolan population lives along the coast: approximately fifty thousand people are dependent on traditional fishing

The impact of climate change along the coast depends on three factors. The first is the increase in sea level, which has substantial inertia and will continue until 2100. The second is the change to maritime coastal currents (the Benguela Cold Current and the Gulf of Guinea current), which are part of the system that redistributes energy at a global level, and may change due to climate change. The third is the modification to sedimentation or erosion along the coast if there are modifications to the hydrology of the rivers that discharge into the Atlantic Ocean.

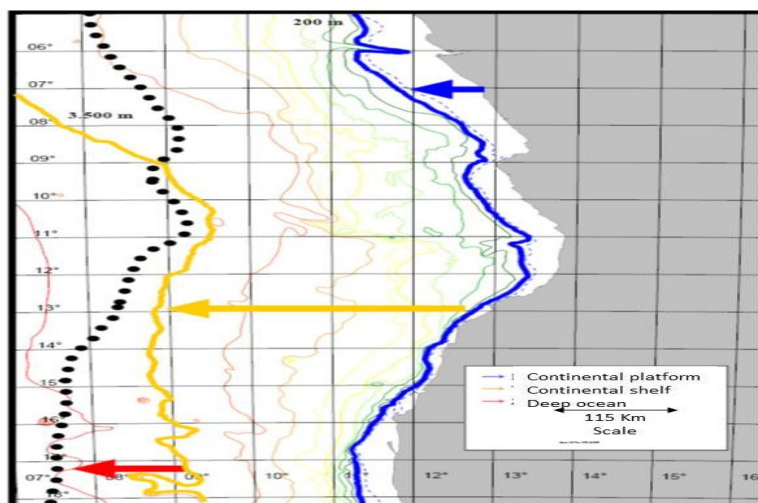


Figure 22: Angola's EEZ (Exclusive Economic Zone)

In Angola's region, there is little available data about sea level for the period from 1960 to 2001, and none for more recent years, of the quality needed to be used to analyse the increase in the average sea level. Global figures indicate that the sea level rose from 1961 at

an average rate of 1.8 mm per year (between 1.3 and 2.3 mm per year) and since 1993 at an accelerated rate of 3.1 mm per year (between 2.4 and 3.8 mm per year). The estimates for global rates in the twentieth century are significantly higher than those for previous centuries. The average worldwide sea level in 2005 was around 50 millimetres higher than in 1990.

Based on the information about the sea level from 1980-1999, three possible scenarios have been projected for the year 2090, with the first pointing to a rise of 0.13 to 0.43 metres, the second to 0.16 to 0.53 metres and the third to 0.18 to 0.56 metres. This indicates that many low-lying areas may be subject to flooding, including areas of Luanda, the country Capital, and other low-lying coastal cities. Low-lying coastal lagoons, which play a key role in regulating the coastal environment, may likely become inundated. In addition, this may increase saltwater intrusion in river deltas and estuaries which combined with increased propensity towards flooding would have a tendency to create inward and outward flooding around major rivers.

Impacts on forests, biodiversity and ecosystems

Angola is one of the most important centres of marine biodiversity and one of the most productive in fishing resources in the world. Its ecosystems are highly diversified, including zones of open sea, islands, estuaries, mangroves and sandy and rocky beaches. A large part of the biodiversity in Angolan territorial waters is not known. Concerns are related to problems of sedimentation, pollution and over-exploitation of resources with the use of unsuitable fishing practices, oil research and production, construction activity and the exploitation of minerals.

The use of mangroves to produce charcoal is one aspect of overuse of resources: in the north there are stretches of mangroves in a critical condition (due to over-exploitation and pollution). Modifications due to climate change create another factor acting pressure in addition to these concerning aspects. The coastal areas are extremely vulnerable to rises in sea level and are consequently considered high-risk zones.

The sensitivity of mammals was studied in 141 national parks in sub-Saharan Africa, two climate scenarios (SRES A2 and B2 emissions scenarios with HadCM3 GCM, for the years 2050 and 2080), using a "IUCN Red List" study for potential losses (Thuiller et al., 2006). Assuming there is no species migration, 10 to 15% of the species are projected to be included in the IUCN categories of species threatened with extinction by 2050, with an increase to 25 to 40% of species by 2080.

NATIONAL CLIMATE CHANGE ADAPTATION PROGRAMME OF ACTION (NAPA)

The impact of variability and climate change in all the socio-economic sectors in Angola could seriously compromise the current efforts towards economic growth and the fight against poverty, as well as sustainable development, if immediate and suitable adaptation measures are not taken. Angola signed up the United Nations Framework Convention on Climate Change and to the Kyoto Protocol and drew up a National Strategy to implement the Convention and the Protocol, with the National Adaptation Programme of Action to climate change forming one of the essential tools for implementing this strategy.

The NAPA was produced under the responsibility of the Angolan Executive, and with the support of the United Nations Programme for the Environment (UNEP) and of the Global Environment Fund (GEF). This Plan was drawn up in accordance with the requirements established by the Convention, guidelines and experience provided by the LDC Expert Group under the UNFCCC and national expertise.

The National Adaptation Plan of Action to climate change complies with the guidelines in decision 28/CP.7 related to directives noted for the establishment of National Adaptation Programme of Actions in less developed countries (LDCs). All the chapters were produced based on this decision and taking into account the aspects surveyed in its planning document.

Angola demonstrates that the country's adaptation to climate change and implementation of the UNFCCC commitments is definitely a national priority today, supported at the highest level, taking into account that:

- In 2000 it adopted the UNFCCC – United Nations Framework Convention on Climate Change;
- In September 2007, it published its National Strategy for the effective implementation of UNFCCC and the Kyoto Protocol;
- In 2004, it regulated the mandate of Environmental Impact Assessments;
- In November 2009 it instituted its AND - National Designated Authority for the Clean Development Mechanism;
- During 2011 it will its 1st National Communication to the UNFCCC;
- During 2011, it will have regularised the legal and institutional framework and established the consequent attributions and responsibilities that will formally apply

to the strategy, the actions, the objectives and the selected resources for adapting to and mitigating climate change.

Objective of the NAPA

The objective of the National Adaptation Programme of Action is to communicate the country's specific and urgent needs related to adaptation to climate change identified during its production on one hand, and on the other hand to present a programme for action that meets its needs and priorities, including communities' anxieties concerning adaptation to climate change, increase Angola's capacity to resist variability and climate change in such a way that they do not interfere in the programmes to Fight Poverty, achieve sustainable development and fulfil the Millennium Development Objectives established by the Executive.

The National Adaptation Plan of Action aims to contribute to reducing the country's vulnerability in relation to the consequences of climate change, as well as to creating adaptation conditions in accordance with the urgent measures and sectoral priorities identified.

The NAPA also serves the following specific objectives:

- Serving as a simplified and direct channel of communication for information about the urgent and immediate needs for adaptation in Angola;
- Strengthening the national capacity in Angolan specialities in the area of vulnerability and adaptation to climate change, thereby guaranteeing a favourable environment for implementing the UNFCCC and,
- Facilitating the ability to prepare and implement the adaptation activities contained in the First National Communication, and meeting the needs of urgent and immediate adaptation.

Principles governing NAPA development and implementation

In line with the urgency of the matter, and in accordance with national development priorities, Angola's NAPA development and implementation respects the following guiding principles:

- Protection of the climate system - for the benefit of present and future generations, in line with the country's responsibilities and capacities, taking into account the shared but differentiated responsibilities arising from the different commitments between developed countries and developing countries;

- Taking preventive measures - to anticipate, avoid or minimise the causes of climate change and mitigate its prejudicial effects, including a cost-efficiency audit of these measures. The measures to be taken must look at the socioeconomic context of the country, encompassing all the economic sectors of the country with activities that have a direct or indirect relationship with climate change.
- Institutional cooperation - The efforts to combat climate change need to be made in cooperation between different government departments with direct and indirect interests, the private sector and civil environmental organisations. This cooperation must also include the principle of international cooperation to achieve the determined ends; and
- Integration - the measures to combat climate change must be appropriate and be integrated into the country's economic development programmes.
- Synergies: The three Conventions of Rio - Climate Change, Biodiversity and Combating Desertification - jointly provide a suitable platform for promoting sustainable development over the next decade. There are various actions within the scope of its implementation at a national level, by different parties, in shared areas, specifically soil and water conservation, forestry, agriculture, coastal zones, etc. Based on a principle of a return on resources, an integrated approach can be adopted to combine certain activities in specific fields, namely Information, Education and Communication; Research; Observation and systematic monitoring; Prevention and Management of Catastrophes; Technology Transfer.

Potential barriers to implementation

There are a series of barriers that may affect the implementation of NAPA priorities at national, provincial and local level. The principal constraints on its implementation are particularly related to the lack of material and financial resources, as well as structural barriers such as lack of technical capacity, limited human capital and institutional coordination. The NAPA development team has identified these constraints during the NAPA consultations:

- The limited availability of financial resources to implement adaptation measures;
- Lack of scientific data, historical climate information, monitoring networks and analytical capacity;
- Extreme poverty, low levels of health and education;
- Scarcity of human resources with the skills to translate the strategies into actions at a community level where the impacts of climate change are evident.
- Lack of involvement by the private sector in questions related to climate change;

- Limited capacity among non-governmental actors to comprehend and engage on climate change issues.

Summary of NAPA development process

As mentioned above, the NAPA was developed in accordance with available guidance and best practices made available through the UNFCCC and UNEP, and a process was adapted based on Angola's national circumstances. The large area of the country, as well as intra-regional variability and diversity has made it difficult to fully reflect the breadth and complexity of adaptation and vulnerability issues in every part of the country.

The NAPA exercise began with the definition of climatic and socio-economic scenarios that are used to anticipate a combination of future impacts. These impacts are often negative but there are also frequently opportunities that need to be identified. The response to climate change involves an interactive process of risk management that includes adaptation and/or mitigation and takes into account the forecasts for climate change, the benefits, sustainability, balance and attitude toward risk. As noted in earlier chapters, the lack of reliable historical data and climate models for the country has hindered the production of rigorous climate scenarios that could help pinpoint with a higher degree of accuracy the amplitude of expected climate impacts.

The methodology used in producing this document combined documentary analysis of vulnerability and climate-related information, analysis of socio-economic parameters as well as consultations with relevant authorities and institutions, including NGOs and vulnerable communities. To better understand vulnerability across the whole country, it was decided to divide Angola into 5 geographic areas, in which each one represented a type of vulnerability. The Provinces of Cabinda, Bie, Moxico, Kuando Kubango, Namibe and Cunene were identified and covered by participatory surveys as pilot areas for the following vulnerabilities:

- Province of Cabinda – vulnerability in terms of ecosystems, biodiversity and forests;
- Province of Bie – vulnerability in terms of food security and agriculture;
- Province of Moxico – vulnerability in terms of health and education
- Province of Namibe – vulnerability in terms of the coastal zone, infrastructure and fishing;
- Province of Kuando Kubango – vulnerability in terms of water resources;
- Province of Cunene – integrated vulnerabilities.

In each province, consultations took place at 4 different levels, with authorities, non-governmental organisations, private sector as well as the population of specific locations

providing greater evidence to describe the type of vulnerability and providing input into a list of adaptation priorities. For each of the provinces, the consultations were coordinated by a consultant or a team of consultants, taking specific surveys over 3 days. The methodology for surveying the vulnerabilities included themed meetings in the previously identified specific areas, collecting indications of vulnerability, interviews, bibliography, as well as a general characterisation of the vulnerabilities identified. A general ranking of climate threats was derived from the consultations based on historical and visual observation.

The adaptation priorities were then identified and listed by the consultants who went to the provinces and based on the surveys undertaken, evidence of changes in the *modus vivendi* of the populations consulted, as well other information collected by people who worked at some point on these themes in the areas referred to.

The long list of possible response options (30) was drawn up, and prioritized by the NAPA team according to a multi-criteria analysis method that included benefits on the most vulnerable populations segments and sectors, as well as considerations of costs and other socio-economic benefits. This is presented further below.

Summary of the consultations

The NAPA team divided the country into 5 geographic regions, namely the North, South, Centre, East and West. On this basis, and taking into account its forestry potential, the province of Cabinda was chosen for an evaluation of forests, biodiversity and ecosystems, the province of Bié saw the strategy for food security as a critical area with the group in this area deciding to assess vulnerability in agriculture and food security; the province of Namibe was chosen for consultations about the coastal strip and infrastructure, the province of Kuando Kubango for water resources and the province of Moxico for human health.

In addition to the provincial surveys, the group decided it was worthwhile to undertake an integrated evaluation of vulnerability in the province of Cunene, based on the events caused by consecutive floods. The *fishing* communities in the locations of Tombwa and around the city of Namibe underlined the need to proceed with a major project to monitor the weather, climate and oceanographic conditions, enlarge and expand the network of meteorological stations, develop a programme to combat land degradation, study the causes of fishing scarcities that have worsened in the last 10 years, develop projects or programmes aimed at reducing the occurrence of preventable water-based endemic diseases, undertake massive campaigns to build latrines and community bathhouses throughout the province, undertake massive campaigns of urban tree planting and forest repopulation, encouraging programmes of awareness and distribution of nutritional information with a view to using other food sources and diversifying the population's diet, reinforcing permanent rural trade

as an incentive to increase the production and incomes with repercussions on the well-being of rural populations;

In relation to *forests, biodiversity and ecosystems*, the population requested monitoring of the region's climate, taking into account the late arrival of the rains, their intensity and the vulnerability of human activities, campaigns for environmental education and awareness, the introduction of alternative and sustainable income sources for rural populations in marginal zones, and more studies of the climate in the region.

In relation to *agriculture and food security*, the communities in Kuito and Camacupa, suggested greater monitoring of the weather and climate, enlarging and expanding the network of meteorological and agro-meteorological stations, whether INAMET or MINADERP, in towns and communities, the preparation of climate information kits in local languages and distribution throughout the population, adding dynamism to the early warning service for food security to fill the void in the distribution of climate information to agricultural workers and rural producers, improving the operation of the civil protection and social assistance service to help populations in the case of emergencies, specifically floods, droughts and losses in production associated with them, agricultural and food security protection, improving and providing techniques and materials (agricultural inputs, instruments and materials, manure, fertilisers, pesticides and quality seeds), providing more agricultural technicians to improve assistance to rural producers accompanied by other essential services, namely education and training, health, assistance and social security, the provision of funds to build silos, facilities for conserving and processing agricultural production to remove the excess supply that contributes to the fall in prices and consequently the impoverishment of the rural population, encouraging programmes or linking the existing one to those about awareness and distribution of nutritional information with a view to the use of other foods to diversify the population's diet, the construction of rural infrastructure, specifically secondary and minor roads to facilitate the transport of agricultural production, the introduction of seeds of agricultural varieties adapted to the climate changes recorded in the country.

In relation to *water resources*, the communities of Kuando Kubando and Cuchi suggested monitoring and regular surveying of the hydrographic basins in the region more deeply for adaptation to the vulnerability of water resources and consequently aquatic ecosystems, installing hydraulic rams to guarantee the supply of water to them, the creation of a social awareness group that helps the NGOs in raising awareness among the population, as that is one of the measures that could help the population to mitigate the problems caused by the alterations in the climate in the last 10 years, installing and increasing the number of meteorological and hydrometric stations to analyse the impact of floods and rivers breaking their banks, effective management of different forms of use of water resources, the development of warning and forecasting systems, analysing the impact of floods on water

and soil quality, creating plans for institutional recovery and the human resources for monitoring and managing water resources.

In relation to *health*, the communities recommended supplying drinking water to the population, carrying out disease prevention campaigns, studying the causes of epidemics as yet unknown and their consequences for society, improving the study and understanding of tropical epidemics, the population's awareness in relation to tropical epidemics, financial and material support for the literacy programme, the construction of more schools and increased campaigns for awareness about education, principally among women and children.

Analysis of climate threats, vulnerabilities and adaptation needs

An analysis of various climate change threats was performed. Based on the guidelines developed by the LEG for the development of NAPAs, a double prioritization and ranking process was used following the PVA meetings in each province.

Taking the list of climate-related threats put forward by stakeholders during the provincial consultations, a short-list was prepared including direct climate change and climate variability threats, and indirect threats. This list was then ranked according to its impacts on various sectors and vulnerable segments of society. The result was used to determine the most vulnerable sector or group, and the most significant threat. The result is presented below:

Threat	Impact (ranked from 0 to 5, 0 being no impact, and 5 being high impact)								
	Agriculture and fisheries	Health (incl. sanitation)	Infrastructure (buildings, ports, roads, cities)	Environment (incl. forests, biodiversity, water)	Loss of life	Economy (including extractive industry)	Rural	Urban	TOTAL
Direct threat									
Sea level rise	2	1	2	1	0	2	1	1	10
Increased Sea Surface temperature	4	3	0	3	0	2	1	1	14
Higher temperature	4	4	0	2	1	0	3	4	18
Late onset of rain	4	2	1	2	0	3	5	2	19
Drought	4	4	2	4	1	3	5	3	26
Floods	4	5	4	4	4	4	5	4	34
Indirect threat									
Heat waves	4	4	1	2	1	1	1	2	16
Loss of vegetative cover	4	2	0	4	0	1	4	2	17

Habitat transformation	4	2	3	3	1	3	3	2	21
Coastal erosion	3	2	4	2	4	3	2	3	23
Water erosion	4	3	4	2	4	4	4	5	30
TOTAL	41	32	21	29	16	26	34	29	228

From this table it appears that **the most vulnerable sector is agriculture and fisheries, followed by health** - and that rural peoples are more vulnerable than urban populations. It also appears that the most significant climate-related threats are **flooding and water-induced soil erosion**.

Because, in the eye of the general public, vulnerability to climate change and general vulnerability is difficult to distinguish, the NAPA team had to undertake an exercise whereby prevalent non-climate change factors of vulnerability were disaggregated from climate-related vulnerabilities. The result is presented below, according to thematic issues:

Agriculture

Climate Change risks

- Intensity and irregular frequency of rainfall;
- Abrupt variations in temperature and relative air humidity;
- Increase in Heat;
- Increase in Cold;
- Prolonged droughts;
- Flooding;
- Increase in wind frequency and intensity;
- Reduction in wind frequency and intensity;
- Greater uncertainty about climatic variability;
- Increase or reduction in variability of precipitation

Constraints to Adaptation

- Uncontrolled burning;
- Existence of invasive species and pests;
- Lack of access roads;
- Declining crop yields;
- Lack of access to agricultural inputs (seeds, fertilizers, labour and tools)
- Degradation of soils;
- Burning agricultural waste;
- Denuding by itinerant agriculture;
- Existence of animal diseases (zoonosis)

Coastal zone

Climate Change risks

- Intensity and irregular frequency of rainfall;
- Variations in temperature and relative air humidity;
- Prolonged droughts;
- Flooding;

Constraints to Adaptation

- Destruction of Mangroves;
- Unplanned construction;
- Habitat destruction;
- Coastal Erosion;
- Marine and Coastal pollution;

Increase in wind frequency and intensity;
 Reduction in wind frequency and intensity;
 Transformation in the Benguela Cold Current
 Sea level rise

Mineral Extraction, sand and coral mining;
 Existence of non adapted construction, infrastructures and roads

Biodiversity, Forests, Ecosystems

Climate Change risks
 Intensity and irregular frequency of rainfall;
 Abrupt variations in temperature and relative air humidity;
 Changes in temperatures
 Prolonged droughts;
 Flooding and/or siltation in water bodies;
 Increase in wind frequency and intensity;
 Reduction in wind frequency and intensity;
 Sea level rise,
 Saltwater intrusion in aquifers and rivers
 Ecological modification leading to invasive species and new pests and pathologies

Constraints to Adaptation

Destruction of mangroves
 Deforestation for energy use
 Encroachment on protected areas
 Excessive use of medicinal plants
 Invasive species and pests
 Poaching
 Lack of environmental consideration in industrial and mining development
 Overfishing
 Coral and sand mining

Water resources

Climate Change risks
 Rainfall variability;
 Reduced river flows, siltation or flash flooding
 Abrupt variations in temperature and relative air humidity;
 Prolonged droughts, slower aquifer recharge;
 Increase in wind frequency and intensity;
 Changes in currents and climate patterns

Constraints to Adaptation

Population increase and increase in water demand
 Disrepair in flood control infrastructure
 Absence of IWRM frameworks and practices
 Outdated water extraction techniques
 Overpumping and inefficient irrigation
 Lack of information, scientific data and analytical capacity

Health

Climate Change risks

Rainfall variability

Impacts on water availability

Flooding

Heat increase

Saltwater intrusion in aquifers and rivers

Decreased crop yields

Constraints to Adaptation

Poverty

Lack of access to medical care

Lack of access to adequate sanitation and waste management

Outdated infrastructure

Prevalence of vector-borne diseases

Informal settlements

ADAPTATION CAPACITY NEEDS

This section discusses how Angola can create the adaptation capacities necessary, in each sector, to deal with the impact of climate change and also recommends some general measures, taking into the account the level of uncertainty and the limited amount of existing data.

Future projections related to rainfall, run-off and soil humidity are still very uncertain, there is not sufficient information available on the possible impact of climate change in Angola, but it is also inappropriate to presume that the climate and hydrological conditions of the past will continue in the future.

The strategies presented aim to reduce the current risks that are likely to increase due to changes in temperature and rainfall. Capacity building to face the current situation (soil erosion and flooding for example) will be useful to prepare for future vulnerabilities that may become more critical. These capacities can be built at individual, community, local government and central government levels. Adaptation policies should increase the capacity to manage the risks at these levels and should avoid fixed large scale investments that depend on factors that are still insufficiently studied.

Incorporating climate change risks in the planning and investment of infrastructures, development programmes and even urban planning is becoming increasingly necessary. This implies gathering information and resources and the strengthening of institutions.

Hydrology

In the area of hydrology, it is important to continue the activities in place to improve knowledge on the Angolan water basins. The study of these water basins was incomplete before independence and was interrupted during the years of civil war. Information on the variability of river and stream flows and the factors that contribute to this vulnerability are required for, the planning of the use of rivers for irrigation or for hydroelectric power stations, the design of drainage and run-off systems and to prevent floods.

Further studies are required on the factors that contribute to the risk of flooding and pilot projects to reduce flooding impacts and occurrence, need to be developed. There are four different types of strategies to manage floods:

- Prevent: actions against the factors that contribute to flooding such as the lack of natural vegetation cover;
- Protect: the construction of physical barriers to protect areas at risk;
- Accommodate: meaning living with the risks but preparing better for them;

- Retreat: evacuating risk areas.

A combination of each of these strategies should be tested, and developed locally depending on optimal conditions and costs and benefits.

Complementary measures include, mapping the dangers that affect communities to understand the risks and the health and hygiene training required to reduce the risk of the spread of disease that results from high water levels. Warning systems and improving the resilience of houses are some of the measures used when learning to live with the threat of floods. The Red Cross estimates that these types of accommodating actions represent 25% of the costs of humanitarian aid after floods.

Furthermore, there is a lack of capacity to understand sedimentation and siltation processes in major rivers, and the links between different basins. There is a need to increase knowledge of water basins, including groundwater potential and projections of water availability for future uses under climate change scenarios. The impact of rainfall variability on the country's water balance is also unknown.

Geology

Controlling erosion can be improved in Angola and demands the immediate implementation of measures. The capacities of municipalities, communes and the communities themselves must be improved to reduce the risks of erosion and to prevent an increase in the areas that are currently affected by erosion. Reducing the risk of erosion involves a reduction of the surface that is exposed to water action and a decrease in the distance and speed at which water crosses surfaces. It implies that the huge amount of water that runs across concrete and tarmac surfaces, be properly channelled into drains or safe infiltration points.

In terms of soil erosion, it is important to study the human and natural factors that contribute to the risk of erosion. Maps of the areas at risk from erosion and pilot projects that create local capacities to execute actions that reduce the risk of erosion need to be developed and a better understanding of unsustainable land use practices needs to be derived among the concerned institutions (deforestation for energy and agricultural expansion, burning, inadequate land use planning).

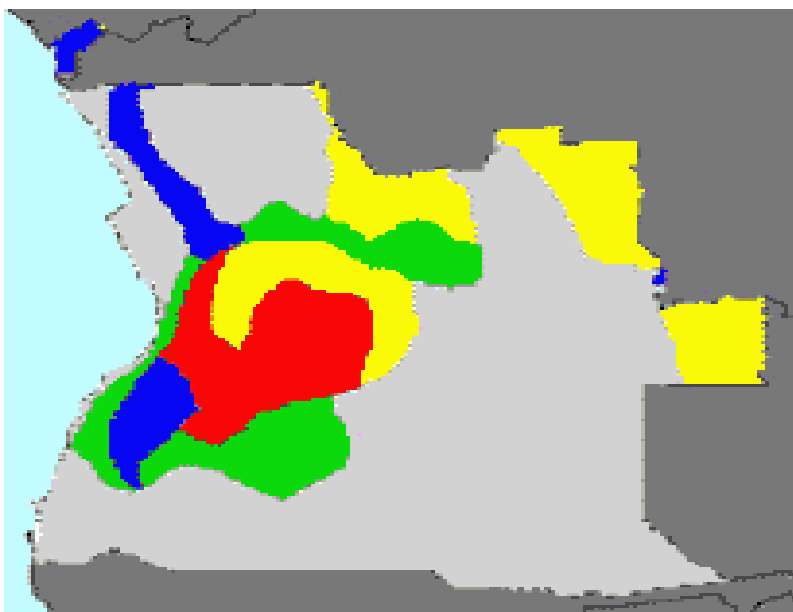


Figure 23: Soil Degradation (REGA) (Grey - none, yellow - low, green - moderate, blue - severe)

Agro-Meteorology

Angolan climate is diverse and farming systems are adapted to these conditions. It's important to understand the farming systems in the different climate zones of Angola and how they have evolved since the 70s. It is important to understand the areas of risk in these systems and how the variability of rainfall and temperatures can affect these systems. More specifically, agro-ecological models and climate-based agricultural planning could serve as an engine for sustainable and resilient development in rural communities. Changes in crop yields and crop pests should be further studied.

A reduction in the vulnerabilities that agriculture currently faces, especially small-scale farming, can contribute to the preparedness for adaptation to climate change. Difficult access to seeds that are adequate to local conditions is one of the vulnerabilities that farmers and peasants face in various parts of Angola. The national gathering of local seeds can be the basis of a programme to create varieties that are adapted to local conditions, with the participation of farmers and peasants.

In-depth study is necessary on the implications of changes in the geographic distribution of animal diseases and the availability of water for livestock production.

There is insufficient climate monitoring infrastructure and as a result, early warning is nearly impossible in the country. Agricultural planning and extension as a result is also difficult due to the lack of appropriate seasonal forecasts.

Epidemiology

Climate change can impact the distribution of diseases but historic data demonstrates that the most important factor in the variations in mortality and morbidity is the presence of control measures. Therefore, it will be key to continue to implement the hygiene and hygiene vigilance system and to continue to improve the control and prevention of the most widespread diseases in Angola.

One capacitating action for the adaptation may include the gathering of more precise information on the geographic distribution of human diseases and their prevalence in relation to rainfall, temperature and extreme events in Angola (such as floods and droughts). Another will be improving the healthcare system for more extreme situations, such as flooding or heat islands in urban centres. The training of staff, the development of strategies, the pre-positioning of equipment, drugs and warning systems can help prepare for a climate with extreme events. Closely following disease trends and the variables related to their prevalence help prepare for the high risk periods. Communicating with individuals so that they can be prepared for high risk periods is necessary.

Institutional Context for Adaptation

This section describes some institutions as well as projects or programmes to be developed that demonstrate some partnership potential and capacity to intervene in relation to vulnerability and adaptation to climate change, but in many cases additional specialised training and skills are needed to adapt to climate change, and resources need to be provided to carry out certain projects and programmes, including:

National Development Framework

Strategy to Fight Poverty

The Strategy to Fight Poverty (SFP), approved by Resolution 9/04 of 4 June, includes environmental considerations in accordance with the Millennium Objectives, some of which relate to climate change. The measures presented within the scope of sustainable development of natural resources, include an evaluation of the level of degradation of natural resources with mapping studies in the vulnerable areas, forest repopulation, and the promotion of pilot activities to combat ravines forming using biological techniques. The ECP sets out that the measures need to be implemented based on intervention plans to be drawn up by the responsible ministries (namely MINAMB and MINADERP), together with the Provincial Governments and with public consultation.

National Plan 2010 – 2011

The National Plan for 2010-2011, approved by Law 1/10 of 15 January, has the following objectives, among others: implementing a rural and suburban development policy that mitigates the inequality in quality of life between rural and urban areas, refurbishing and developing the infrastructure needed to reconstruct and develop the country, promoting accelerated industrial development aimed at replacing imports, ensuring rapid urbanisation of shanty towns and modernising urban communities, and pursuing the process of implementing the National Programme for Climate Change.

National Strategy for food and nutritional security

The National Strategy for food and nutritional security and its Plan of Action, approved by Resolution 130/09 of 29 December, recognises the right to food as fundamental and aims to create conditions to guarantee that every Angolan citizen has lasting food security, reducing the level of inequality in income distribution and structurally reducing extreme poverty. The objectives for actions that may be related to climate change themes are: increasing and

diversifying agricultural, livestock and fishery production in a sustainable way to improve the standards of the populations' food supply and their living conditions; creating and implementing national and local rapid warning systems, monitoring systems for food and nutritional security, as well as mechanisms for communicating with and providing information to families; and creating an inter-sectoral platform for coordinating policies and actions in matters of food and nutritional security, with participation from civil society.

National plan for preparation, contingencies, response and recovery from calamities and natural disasters

In terms of civil protection, progress has been seen with the approval of the National Plan for Preparation, Contingencies, Response and Recovery from Calamities and Natural Disasters 2009 - 2014, approved by Presidential Decree no. 205/10 of 21 September. The general objective of the National Plan for Preparation, Contingencies and Response is to define the lines of force that guide a suitable and concerted response, the conditions and the essential means to minimise the adverse effects of serious accident or catastrophe that affects the Angolan population. The planned response is given in the legal framework for Civil Protection and international standards. The involvement and participation of national and international partners when necessary must consist of supporting Government actions to provide assistance, in a coordinated way, to save the lives of those at risk and meet the humanitarian needs of the population. The Plan sets out scenarios for 1. Floods and mudslides that may be: Localised — activating the Provincial Plan; Medium — activating the National Plan; Exceptional — Activating the National Plan, with a declaration of a state of emergency and a request for international health; 2. Drought: Activation of provincial or national plans depending on the magnitude of the phenomenon.

Partner institutions

In addition to all sectoral ministries at national and provincial levels, the implementation of adaptation in the country could involve scientific communities, universities and academic institutions, as well as private sector and non-governmental organizations. Below are a few of these institutions whose current work and contributions could assist in implementing the NAPA.

Centre for Population Studies and Research (CEIP), multi-disciplinary unit that carries out studies and research into population, in collaboration with the United Nations Fund for Population (FNUAP).

Engineering laboratory for separation, chemical reaction and the environment (LESRA), which constitutes a UNESCO Project associated with the University of Porto and the SANTANDER Group.

National Plant Genetic Resource Centre (CNRF), a multi-sectoral unit covering flora biodiversity, including resource management. Part of the SADC regional network. It has a project underway: “Plant Genetics Resources Collection for Emergency and Conservation Purposes”.

Herbarium of Luanda, Faculty of Sciences, which forms part of SABONET - the Southern Africa Botanic Network - and covers the preservation and study of flora heritage. It is home to around 35,000 examples of plants from different parts of the country.

Centre for advanced studies in education and medical training (CEDUMED), Faculty of Medicine.

Centre for education research, training and management (CPFGE), ISCED/Lubango. In collaboration with the UAN, the Sonangol Laboratory for Exploration and Production (LEP) undertakes research projects into areas of the environment, image analysis and processing, micropaleontology, petro-physics, petrography, sedimentology and simulation of oil reservoirs.

NATIONAL ADAPTATION PRIORITIES

Following the consultations and the analysis of vulnerabilities, a list of responses to each threat was designed, using also input from the provincial consultations where adaptation options and actions were suggested. The list of 30 options was then ranked according to its potential benefits and costs. The results of this ranking process have provided a prioritized long list of adaptation options:

Response option	Benefit (0 to 5, with 0 being no benefit and 5 being high benefit. In case of cost ranking is 5 to 1, 5 being low cost (below 1 million), 3 being medium cost (5 to 10) and 1 being high cost (more than 10 million)										
	rural livelihoods	urban development	health	education	poverty reduction	Benefits to most vulnerable	economic growth	environmental conservation	synergies among conventions	Cost	TOTAL
promote alternative renewable energies for avoided deforestation	4	4	2	1	4	4	3	4	4	1	
promote SLM for increased agricultural yields	4	0	2	2	4	4	3	3	4	1	31
Ensure basis access to health services and health monitoring	3	4	4	3	4	4	3	1	0	1	27
Study the vulnerability of the fisheries sector to climate change and current modifications	4	3	2	0	3	3	2	3	3	3	26
Extend electricity grid to rural areas	4	0	3	2	3	3	4	4	2	1	26
revise sectoral laws for proactive adaptation	4	4	3	2	3	3	2	2	2	1	26
Create an early warning system for flooding and storms	4	4	3	3	1	3	3	2	1	1	25
National institutional mechanism for adaptation planning and mainstreaming	3	3	2	2	3	3	3	3	2	1	25
soil erosion control through organic methods	4	0	2	0	4	3	3	4	3	1	24
diversify crops to less climate sensitive cultures	4	0	2	0	4	4	3	3	3	1	24
technology needs assessment	3	3	3	2	3	3	3	2	1	1	24
Variedades adaptadas as condições locais	4	0	2	1	4	4	3	1	1	3	23
Climate monitoring and data management system	2	4	2	1	3	2	3	3	2	1	23
Study the implication of climate change on disease patterns for humans and livestock	4	1	1	1	3	3	2	3	1	3	22
Increase water availability through village-level wells and borehols	4	2	3	1	3	4	1	1	2	1	22
Implement water resources integrated management	3	3	3	0	3	3	3	2	1	1	22
Map Areas of erosion risk	3	3	1	1	1	2	2	3	2	3	21
implement water harvesting systems in drought-prone areas	4	2	2	1	3	4	1	1	2	1	21
Improve knowledge of hydrology	4	3	2	1	3	3	2	1	1	1	21

extend water and sanitation network to rural areas	4	0	3	1	3	4	2	2	1	1	21
explore industrial opportunities from climate change?	0	4	2	2	3	2	4	2	1	1	21
Monitor groundwater	3	1	1	1	3	3	2	1	1	3	19
Construct flood protection barriers along major rivers	4	3	1	0	3	3	2	1	1	1	19
Study impacts of sedimentation and siltation rates on coastal processes	3	3	0	2	2	3	1	1	1	3	19
Improve design and construction of buildings	2	4	3	0	2	3	1	3	0	1	19
study impact of climate change on hydroelectricity	1	4	1	0	2	2	2	2	1	3	18
Revise building codes to promote retreat from flood plains and coastal zones	2	3	1	2	2	3	1	3	0	1	18
Construct sea level protection structure	0	4	0	0	2	2	2	1	1	1	13
study impact of climate change on mining	0	0	2	0	3	0	2	2	1	3	13

From the table above, it results that the top 15 priority adaptation actions for Angola are as follows (by order of priority):

1. Promote alternative renewable energies for avoided deforestation
2. Promote SLM for increased agricultural yields
3. Ensure basis access to health services and health monitoring
4. Study the vulnerability of fishing activities in relation to modifications of climate and currents
5. Extend electricity grid to rural areas
6. Revise sectoral laws for proactive adaptation
7. Create an early warning system for flooding and storms
8. National institutional mechanism for adaptation planning and mainstreaming
9. soil erosion control through organic methods
10. diversify crops to less climate sensitive cultures
11. technology needs assessment
12. Variedades adaptadas as condições locais
13. Climate monitoring and data management system
14. Study implications of changes in disease patterns (animal) and availability of water for livestock
15. Increase water availability through village-level wells and boreholes

NAPA project profiles

A number of projects were identified by the National Plan of Action for Climate Change whose urgent and immediate implementation would serve to address the adaptation needs of the country. The implementation of these projects represents materialisation of the strategy to implement the NAPA: other initiatives or projects may be developed during its

implementation in line with more specific needs and financial opportunities. Costs estimated are indicated for all priorities. Project profiles were developed for the first 5 priority projects, recognizing that resources may not be immediately available for addressing all NAPA priorities. Project development will continue during NAPA implementation.

Although the list of priorities provides a low ranking to project that aim at building institutional capacity and awareness raising, these issues may have to be addressed at an early stage to ensure that the foundation for adaptation capacity is established in the country for the long-term.

The estimated costs indicated in the table below have been based on an analysis of the costs required to implement the project in the most vulnerable area, rather than for the entire country.

Project	Estimated cost (Million USD)
Promote alternative renewable energies for avoided deforestation	3.5
Promote SLM for increased agricultural yields	5
Ensure basis access to health services and health monitoring	3
Study the vulnerability of the fisheries sector to climate change and current modifications	2
Extend electricity grid to rural areas	5
Revise sectoral laws for proactive adaptation	2
Create an early warning system for flooding and storms	3.5
National institutional mechanism for adaptation planning and mainstreaming	2
Soil erosion control through organic methods	4
Diversify crops to less climate sensitive cultures	3
Technology needs assessment	0.5
Locally available adapted seed varieties	5
Climate monitoring and data management system	17,5
Study the implication of climate change on disease patterns for humans and livestock	1,5
Increase water availability through village-level wells and boreholes	5
Implement water resources integrated management	3
Map Areas of erosion risk	1
Implement water harvesting systems in drought-prone areas	3
Improve knowledge of hydrology	2
Extend water and sanitation network to rural areas	10
Explore industrial opportunities from climate change	1
Monitor groundwater	3

Construct flood protection barriers along major rivers	5
Study impacts of sedimentation and siltation rates on coastal processes	3,5
Improve design and construction of buildings	1
Study impact of climate change on hydroelectricity	1
Revise building codes to promote retreat from flood plains and coastal zones	1
Construct sea level protection structure	10
Study impact of climate change on mining	0,5

Selected Project Profiles

PROJECT 1: PROMOTE ALTERNATIVE RENEWABLE ENERGIES FOR AVOIDED DEFORESTATION	
Introduction/Justification	<p>Current demands for charcoal and its large-scale use in the last 30 years have probably had a significant impact on the natural forest called “miombo”. One of the most affected provinces is Huambo. Interviews conducted with farmers near Huambo city indicate that charcoal production took place about 10 km from the city 20 years ago, but now could only be found 50 to 60 km outside of the city. Huambo Province is the closest area to the cities of Benguela and Lobito. Charcoal was produced in the coastal areas close to these cities, and even on the coastal mangroves during the war, but after the war, it was rapidly transferred to the Huambo Province, once it became safe to do so.</p> <p>Deforestation, whether for energy needs or for agricultural expansion, is a major barrier to adaptation and creates additional soil degradation pressure, leading to increased flooding impacts, lower agricultural productivity and ecological sensibility. It is important to ensure appropriate land cover so as to avoid the negative impacts of climate change.</p>
Objective	Reduce pressure on forests through the use of alternative energy sources; ensure increased soil cover.
Activities	<ul style="list-style-type: none"> - Mapping the vulnerable areas; - Identify and develop local renewable energy sources (Biomass residues, Solar cookers or fuel efficient stoves, Biodigestors) - Identify potential for small hydro - Undertake reforestation in heavily degraded areas.
Responsibility	National Directive on Renewable Energy (DNER) Ministry of Agriculture
Costs	Costs are estimated at 3.5 million for 1 vulnerable location in the province of Huambo.

PROJECT 2: PROMOTE SUSTAINABLE LAND MANAGEMENT TO INCREASE AGRICULTURAL YIELDS	
Introduction/Justification	Climate variability and climate change pose significant risk to agricultural production because extreme variations in rain patterns will impact in production.
Objectives	To promote the sustainable land management to increase the agricultural yields
Activities	<ul style="list-style-type: none"> - Development of Techniques for different crops; - Promote cultivation techniques for increased water retention and erosion prevention; - Promote changes in agricultural practices for the conservation of soil humidity and nutrients, avoiding superficial draining and controlling erosion; - Improvement in the use and availability of water and soil erosion control; - Promote Rotation of cultures and changes in the periods of planting and harvesting; - Development of new varieties of plants and techniques to increase added value; - Drip irrigation and concentration of irrigation on growth periods; - Promote Integration between agriculture, livestock and forestry, and installation of wind breakers; - Promote Reforestation in arid and semi-arid zones; - Techniques to ensure food security and quality; - Development of Methods for fighting pests;
Responsibility	MINADERP
Costs	Costs are estimated at 5 million USD for works at provincial level.

PROJECT 3: ENSURE BASIS ACCESS TO HEALTH SERVICES AND HEALTH MONITORING	
Introduction/Justification	<p>The healthcare situation in Angola is characterized by elevated rates of morbi-mortality caused mainly by the development of infectious diseases, being malaria the number one cause of morbi-mortality, representing more than 50% of medical consultations. The sanitary state is aggravated still by the occurrence of epidemic bouts of cholera, which has become endemic. The healthcare sector will continue to demand special care and large portions of the public budget, unless there are substantial improvements in education, income, housing, sanitation, collective and individual hygiene and infrastructure.</p> <p>It is assumed that the epidemiological picture in Angola will be altered in the context of climate change, with the more frequent occurrence of infectious disease cycles.</p>
Objectives	Prepare and insure population, principally in remote rural areas, have access to preventive campaigns and fully equipped medical centres related to climate-change induced epidemiological variations.
Activities	<ul style="list-style-type: none"> - Gathering more precise information about the geographic distribution of human diseases and their occurrence in relation to precipitation, temperature and extreme events (such as floods and droughts); - Studying the implications of climate change; - Improving the preparation of the healthcare system to handle more extreme situations. - Develop more in-depth studies about the expansion of tropical epidemics and their connection with the climate; - Develop reinforced education and awareness for the population strategies;
Responsibility	Ministry of Health - MINSA
Costs	Costs are estimated at 3 million USD for 1 project in 1 province.

PROJECT 4: Study the vulnerability of the fisheries sector to climate change and current modifications	
Introduction/Justification	Modifications in the Benguela Cold Current can have implications in coastal fishing and, therefore, impact the fishing communities and industry.
Objectives	Encourage scientific investigation, innovation and the valorization of traditional knowledge, improving resource management and managing the coastal area in a more integrated way.
Activities	<ul style="list-style-type: none"> - Gathering information from fishermen about variations and trends in fishing; - Studying the vulnerability of the current fishing activity and if there are changes to currents or the weather. - Establish climate-based models for the Benguela Current and coastal fisheries
Responsibility	Ministry of Fishing
Costs	Costs are estimated at 2 million for 1 study.

PROJECT 5: EXTEND ELECTRICITY GRID TO RURAL AREAS	
Introduction/Justification	<p>The rural sector, which comprises agriculture, forestry and livestock activities, is the second largest producing sector in the country, representing about 8% of the GDP, even though the existence of mines still constitutes an obstacle to rural development.</p> <p>In the energy sector, the National Plan establishes as priorities some measures with potential positive impact on mitigating climate change. One of them is the implementation of the National Electrification Program, which includes: defining a plan for rural electrification, followed by decentralization to provincial governments and municipal authorities of medium and small distributions; promoting the development of local sources, such as mini or micro hydroelectric plants; increasing and diversifying production of electricity from sources such as hydro, solar, wind and biomass; and creating a logic of producing entities that are interconnected and sell energy to a national network.</p>
Objectives	Implement rural electrification through conventional and innovative energy sources
Activities	<ul style="list-style-type: none"> - Develop small and micro scale power plants – hydro, wind and solar - Implement small local grids - Extend the conventional electricity network where feasible - Monitor the rate of connection and illegal connections
Responsibility	Ministry of Energy

CONCLUSIONS

Climate change translates essentially into intense and irregular rainfall, abrupt changes in temperature and relative air humidity, increased heat in some regions, increased cold in others, prolonged, floods, rises or falls in wind frequency and intensity, climatic variability.

Despite the lack of precise knowledge of anticipated climate impacts, and despite significant barriers to implementing adaptation in Angola, the NAPA has provided an essential contribution to the understanding of climate vulnerability and adaptation.

The NAPA is one of the demonstrations of the will of the Angolan Executive in the face of its international commitments related to the United Nations Framework Convention on

Climate Change, particularly the impact of extreme climatic events on the main sectors of socio-economic development.

PANA is the result of a participatory process involving the different parties in the active life of the country and enabled the priority adaptation measures to be identified. The rapid implementation of these adaptation projects will contribute to minimising the negative effects of climate change on the most vulnerable populations and on fragile systems of production.

It is generally accepted that climate changes have already started to happen, and have been caused by man's action on the earth. In some parts of Southern Africa, the climate has become drier over the last 30 years. The disasters related to climate change have been considerable, and it has also caused social and economic impacts that may impede current development efforts.

In Angola, the possible effects from the scenarios generated by the global models for a 50 to 100 year timescale may be the following: the occurrence of extreme climatic events; the extension of arid and semi-arid areas in the south of Angola; a reduction in rainfall below the dividing line between Lubango, Huambo and Malange; an increase in rainfall in the north of Angola; changes in ocean currents; an increase in average sea levels leading to changes in erosion and sedimentation; changes in river currents, leading to modified erosion and sedimentation patterns; change of temperature in lagoons.

Today, the need for adaptation is a fact and so there has to be a human and technical capacity to respond to the problem and it requires intervention from everybody to ensure the survival of future generations is not put at risk.

Due to financial or time difficulties, there were some areas that the National Adaptation Plan of Action did not go into, or went into only superficially. In this context, the information contained in the plan is indicative and the material set out in it needs to be more in-depth.

The most important step in the plan will therefore be its implementation where there are indications of concrete projects and others that could take place with a view to reducing the vulnerabilities identified.

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