2019

DISASTER RISK PROFILE

Flood Drought

Equatorial Guinea

Building Disaster Resilience in Sub-Saharan Africa

Building Disaster Resilience to Natural Hazards in Sub-Saharan African Regions, Countries and Communities

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INTRODUCTION

Disasters are on the rise, both in terms of frequency and magnitude. From 2005-2015, more than 700.000 people worldwide lost their lives due to disasters that affected over 1.5 billion people, with women, children and people in vulnerable situations disproportionately affected. The total economic loss amounted to more than US$ 1.3 trillion. Disasters inordinately affect lower-income countries. Sub-Saharan Africa, where two-thirds of the world's least developed countries are located, is prone to recurrent disasters, largely due to natural hazards and climate change.

The Sendai Framework for Disaster Risk Reduction 2015 – 2030 emphasises the need to manage risk rather than disasters, a theme already present in its predecessors, the Yokohama Strategy and the Hyogo Framework for Disaster Risk Reduction. Specifically, the Sendai Framework calls for the strong political leadership, the commitment, and the involvement of all stakeholders, at all levels, from local to national and international, to *"prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political, and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience"*.

Understanding disaster risk is the Sendai Framework's first priority for action: *"policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment"*. The outputs of disaster risk assessment should be the main drivers of the disaster risk management cycle, including sustainable development strategies, climate change adaptation planning, national disaster risk reduction across all sectors, as well as emergency preparedness and response.

As part of the "Building Disaster Resilience to Natural Hazards in Sub-Saharan African Regions, Countries and Communities" programme, UNDRR hired CIMA Research Foundation for the preparation of 16 Country Risk Profiles for floods and droughts for the following countries: Angola, Botswana, Cameroon, Equatorial Guinea, Gabon, Gambia (Republic of The), Ghana, Guinea Bissau, Kenya, Eswatini (Kingdom of), Côte d'Ivoire, Namibia, Rwanda, São Tomé and Príncipe, Tanzania (United Republic of), and Zambia.

The Country Risk Profiles provide a comprehensive view of hazard, risk and uncertainties for floods and droughts in a changing climate, with projections for the period 2050-2100. The risk assessment considers a large number of possible scenarios, their likelihood, and associated impacts.
A significant amount of scientific information on hazard, exposure, and vulnerabilities has been used to simulate disaster risk.

The EU PROGRAMME "Building Disaster Resilience to Natural Hazards in Sub-Saharan African Regions, Countries and Communities"

In 2013, the European Union approved 80 million EUR financing for the programme *"Building Disaster Resilience to Natural Hazards in Sub-Saharan African Regions, Countries and Communities"*. The programme is being implemented in Africa by four partners: the African Union Commission, the United Nations Office for Disaster Risk Reduction (UNDRR), the World Bank's Global Facility for Disaster Reduction and Recovery (WB/GFDRR), and the African Development Bank's ClimDev Special Fund (AfDB/CDSF). The programme provides analytical basis, tools and capacity, and accelerates the effective implementation of an African comprehensive disaster risk reduction and risk management framework.

PROBABILISTIC RISK PROFILE: METHODOLOGY

PROBABILISTIC RISK ASSESSMENT

Understanding disaster risk is essential for sustainable development. Many different and complementary methods and tools are available for analysing risk. These range from qualitative to semi-quantitative and quantitative methods: probabilistic risk analysis, deterministic or scenario analysis, historical analysis, and expert elicitation.

This disaster risk profile for floods and droughts is based on probabilistic risk assessment. Awareness of possible perils that may threaten human lives primarily derives from experience of past events. In theory, series of historical loss data long enough to be representative of all possible disastrous events that occurred in a portion of territory would provide all of the necessary information for assessing future loss potential. Unfortunately, the availability of national historical information on catastrophic natural hazard events is limited, and data on the economic consequences is even less common.

In the absence of extensive historical data, a modelling approach is needed to best predict possible present and future scenarios, taking into consideration the spatial and temporal uncertainties involved in the analysed process.

This profile simulates a realistic set of all possible hazardous events (scenarios) that may occur in a given region, including very rare, catastrophic events. Potential impacts were computed for each event, taking into consideration associated economic losses or the number of people and assets affected. Publicly available information on hazard, exposure, and vulnerability was used in the analysis. Finally, statistics of losses were computed and summarised through proper quantitative economic risk metrics, namely Annual Average Loss (AAL) and Probable Maximum Loss (PML).

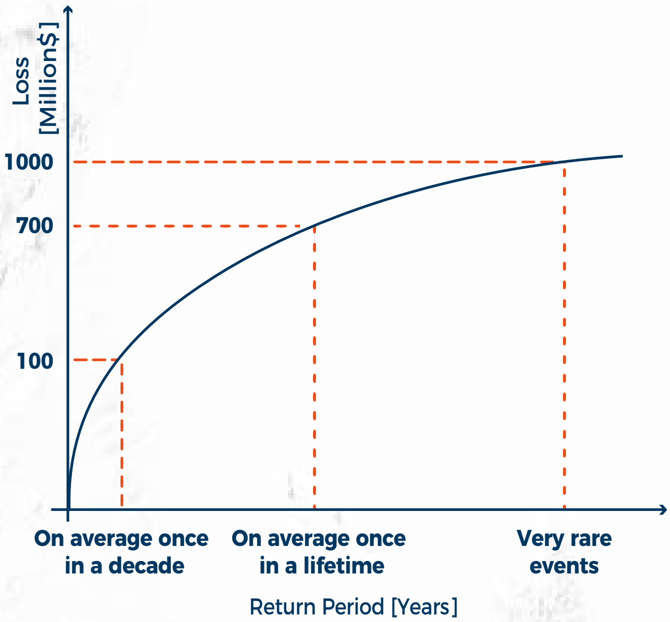
In computing the final metrics (PML, AAL), the uncertainties that permeate the different steps of the computations have been explicitly quantified and taken into account: uncertainties in hazard forcing, uncertainties in exposure values and their vulnerabilities.

Average Annual Loss (AAL) is the expected loss per year, averaged over many years. While there may actually be little or no loss over a short period of time, AAL also accounts for much larger losses that occur less frequently. As such, AAL represents the funds which are required annually in order to cumulatively cover the average disaster loss over time.

Probable Maximum Loss (PML) describes the loss which could be expected corresponding to a given likelihood. It is expressed in terms of annual probability of exceedance or its reciprocal, the return period. For instance, in the figure below, the likelihood of a US$ 100 million loss is on average once in a decade, a loss of US$ 1 billion is considered a very rare event. Typically, PML is relevant to define the size of reserves which, insurance companies or a government should have available to manage losses.

The methodology is also used to simulate the impact of climate change [SMHI-RCA4 model, grid spacing 0.44° - about 50 km - driven by ICHEC-EC-EARTH model, RCP 8.5, 2006-2100 and, future projections of population and GDP growth (SSP2, OECD Env-Growth model from IIASA SSP Database)].

Results are disaggregated by different sectors, using the categories of Sendai Framework indicators: direct economic loss (C1), agricultural sector (C2), productive asset and service sector (C3), housing sector (C4), critical infrastructures and transportation (C5).

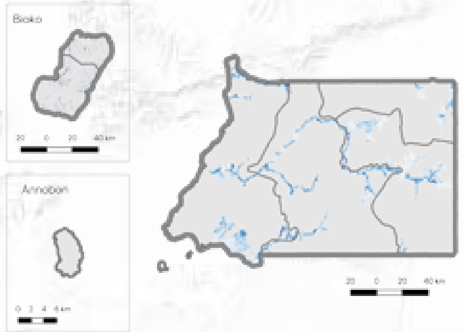


PROBABILISTIC RISK PROFILE: RISK COMPONENTS

HAZARD

process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation.

In order to best predict possible flood and drought scenarios, a modelling chain composed of climate, hydrological, and hydraulic models combined with available information on rainfall, temperature, humidity, wind and solar radiation, has been used. A set of mutually exclusive and collectively exhaustive possible hazard scenarios that may occur in a given region or country, including the most catastrophic ones, is generated and expressed in terms of frequency, extension of the affected area and intensity in different locations.



Flood hazard map for 1 in a 100 years probability evaluated under current climate conditions, the scale of blues represents different water depth values.

VULNERABILITY

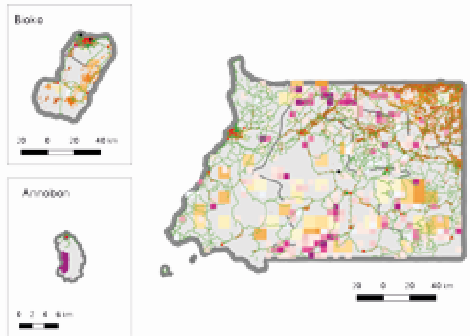
conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

Direct losses on different elements at risk are evaluated by applying vulnerability functions. This links hazard intensity to the expected loss (economic loss or number of affected people) while counting for associated uncertainty. Vulnerability functions are differentiated by the typology of exposed elements, and also take into account local factors, such as typical constructive typologies for infrastructures or crop seasonality for agricultural production. In the case of floods, vulnerability is a function of water depth. For agricultural production, the vulnerability is a function of the season in which a flood occurs. In the case of agricultural drought, losses are computed in terms of lack of production for different crops from a nominal expected production. A similar approach is used for hydrological drought, the evaluation of which focuses on loss of hydropower production.

EXPOSURE

people, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.

Losses caused by floods and droughts are assessed in relation to population, GDP and a series of critical sectors (education, health, transport, housing, and the productive and agricultural sectors). The sectors are created by clustering all of the different components, which contribute to a specific function (e.g. the health sector is comprised of hospitals, clinics and dispensaries). Publicly available global and national data, properly generated, enables the location of these elements at high resolution, e.g. 90 metres or lower, for the whole country. The total number of people and the national GDP (in US$) are considered in both current (2016) and future (2050) scenarios. The critical sectors are characterised in terms of their economic value (in US$), using the most updated information available.



Exposure distribution, the different colors represent different types of assets.

AGRICULTURAL SECTOR [C2] · SERVICE SECTOR [C3] · PRODUCTIVE ASSETS [C3] · HOUSING SECTOR [C4] · TRANSPORTATION SYSTEM [C5] · OTHER CRITICAL INFRASTR.[C5]

UNDRR terminology on Disaster Risk Reduction: https://www.unisdr.org/we/inform/publications/7817

A SENDAI ORIENTED RISK PROFILE

The Sendai Framework guides the organisation of the results of the risk profile. Sendai introduced seven global targets and several indicators for monitoring their achievements. The indicators are common standards for a consistent measurement of progress towards the global targets across countries and over the duration of the Sendai Framework and Sustainable Development Goals. The Risk Profile presents the results of the assessment, mostly referring to indicators for the Target B on the affected people, Target C on direct economic losses and Target D on damage and disruption of basic service. Seven additional indicators are included in the risk profile in order to obtain a more comprehensive understanding of risk from floods and droughts. The table below summarises the indicators used in the risk profiles, as well as the climatic and socio-economic conditions considered in the estimation of the different risk metrics.

	INDICATORS			FLOOD			DROUGHT			
				P	F	SEp	P	F	SEp	RISK METRICS
SENDAI INDICATORS	B1		Number of directly affected people	Y	Y	Y	Y	Y	Y	Annual Average
SENDAI INDICATORS	C1 Direct economic loss attributed to disasters	C2	Direct agricultural loss (Crops)	Y	Y		Y	Y		AAL (Average Annual Loss) / PML (Probable Maximum Loss)
SENDAI INDICATORS	C1 Direct economic loss attributed to disasters	C3	Direct economic losses to productive asset (Industrial Buildings + Energy Facilities)	Y	Y		Y	Y		AAL (Average Annual Loss) / PML (Probable Maximum Loss)
SENDAI INDICATORS	C1 Direct economic loss attributed to disasters	C3	Direct economic losses in service sector	Y	Y					AAL (Average Annual Loss) / PML (Probable Maximum Loss)
SENDAI INDICATORS	C1 Direct economic loss attributed to disasters	C4	Direct economic losses in housing sector	Y	Y					AAL (Average Annual Loss) / PML (Probable Maximum Loss)
SENDAI INDICATORS	C1 Direct economic loss attributed to disasters	C5	Direct economic losses to transportation systems (Roads + Railways)	Y	Y					AAL (Average Annual Loss) / PML (Probable Maximum Loss)
SENDAI INDICATORS	C1 Direct economic loss attributed to disasters	C5	Direct economic losses to other critical infrastructures (Health + Education Facilities)	Y	Y					AAL (Average Annual Loss) / PML (Probable Maximum Loss)
SENDAI INDICATORS	D1 Damage to critical infrastructure attributed to disasters	D2	Number of destroyed or damaged health facilities	Y	Y					Annual Average
SENDAI INDICATORS	D1 Damage to critical infrastructure attributed to disasters	D3	Number of destroyed or damaged educational facilities	Y	Y					Annual Average
SENDAI INDICATORS	D1 Damage to critical infrastructure attributed to disasters	D4	Number of other destroyed or damaged critical infrastructure units and facilities (Transportation systems)	Y	Y					Annual Average
* No official Sendai indicators	Agricultural & Economic Indicators		GDP of affected areas*	Y	Y	Y	Y	Y	Y	Annual Average
* No official Sendai indicators	Agricultural & Economic Indicators		Number of potentially affected livestock units*				Y	Y		Annual Average
* No official Sendai indicators	Agricultural & Economic Indicators		Number of working days lost*				Y	Y		Annual Average
* No official Sendai indicators	Hazard Index	SPEI	Standardised Precipitation-Evapotranspiration Index*				Y	Y		
* No official Sendai indicators	Hazard Index	SSMI	Standardised Soil Moisture Index*				Y	Y		
* No official Sendai indicators	Hazard Index	SPI	Standardised Precipitation Index*				Y	Y		
* No official Sendai indicators	Hazard Index	WCI	Water Crowding Index*				Y	Y		

P Present Climate | **F** Future Climate | **SEp** Socio Economic projection

COUNTRY SOCIO-ECONOMIC OUTLOOK

OVERVIEW

Equatorial Guinea is made up of a mainland territory called Rio Muni, and five islands including Bioko, where the capital Malabo is located [2]. The country has a large and growing young population – about 60% are under the age of 25 – and 26.7 % of the population is urban [3]. The country has been one of the fastest growing economies in Africa in the past decade. After the discovery of large oil reserves in the 1990s, Equatorial Guinea became the third-largest producer of oil in Sub-Saharan Africa, after Nigeria and Angola. More recently, substantial gas reserves have also been discovered. However, the country's macroeconomic and fiscal situation was heavily hit by the drop in oil prices [1]. The government's development agenda is guided by a medium-term strategy, the National Economic Development Plan: Horizon 2020, which targets economic diversification and poverty reduction. Equatorial Guinea is planning to redirect public investment from infrastructure towards the development of new economic sectors and reduce dependence on oil sector. Proper planning that will lead to continued sustained growth and development must include a consideration of the impacts of climate change. The flooding and drought risk assessments presented in this report show the various economic and social impacts of floods and droughts in a changing climate. Thus, they offer an important understanding of risk, essential to the healthy future development of the country.

SOCIO-ECONOMIC PROJECTIONS

Recently, climate scientists and economists have formulated a range of new "pathways" that examine how national and global societies, demographics and economics might lead to different plausible future development scenarios over the next hundred years [4,5]. The scenarios range from relatively optimistic trends for human development, with "substantial investments in education and health, rapid economic growth and well-functioning institutions" [6], to more pessimistic economic and social stagnation, with little investment in education or health in poorer countries, coupled with a fast-growing population and increasing inequalities.

PROJECTIONS USED IN THE RISK PROFILE

The "middle of the road" scenario used in this risk profile envisages that the historical patterns of development are continued throughout the 21st century. Following this projection, the population of the Equatorial Guinea should increase by roughly 18% between 2016 and (World Bank Data), whereas GDP should increase more than six-fold.

POPULATION

2016 Projection
1.2
[Million People]
1.4
2050 Projection

GDP

2016 Projection
11.3
[Billion$]
67.7
2050 Projection

EQUATORIAL GUINEA

AREA : 28,052 km^2 *(GUINEAECUATORIALPRESS.COM)*

POPULATION DENSITY : 47 people/km^2

MEDIAN AGE : 22.2 years

HDI - HUMAN DEVELOPMENT INDEX : 0.591 *(UNDP - 2017)*

LIFE EXPECTANCY AT BIRTH : 57.9 years *(UNDP - 2017)*

MEAN YEARS OF SCHOOLING : 5.5 years *(UNDP - 2017)*

EMPLOYMENT TO POP. RATIO (AGES > 15) : 55.1% *(WB - 2017)*

EMPLOYMENT IN AGRICULTURE : 59.5% *(WB - 2017)*

EMPLOYMENT IN SERVICES : 34.1% *(WB - 2017)*

data from:
http://hdr.undp.org/en/countries/profiles/
https://data.worldbank.org/indicator/
https://www.guineaecuatorialpress.com

COUNTRY CLIMATE OUTLOOK

OVERVIEW

The Republic of Equatorial Guinea is located on the western coast of Africa and includes a number of islands in the Gulf of Guinea, the largest of which is Bioko Island, to the north-west of the mainland. The continental mainland of Equatorial Guinea lies low at the coast, rising up into mountains and valleys further inland. The climate is typically equatorial with high temperatures, high humidity and heavy rainfall.

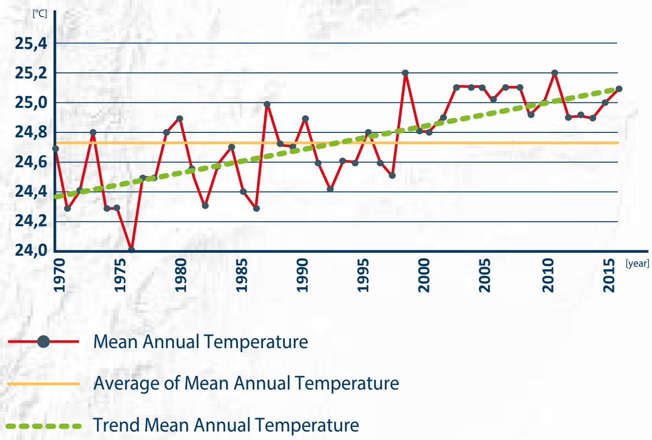
Temperatures vary little with the seasons, but they decrease with altitude in the inland regions. The main wet season lasts between April and October, when the West African Monsoon winds blow from the south-west, bringing moist air from the ocean. The wettest regions of Equatorial Guinea during these times are the coastal regions [7,8,9]. Average annual precipitation for Equatorial Guinea is 2159 mm, while the mean number of wet days is 170.

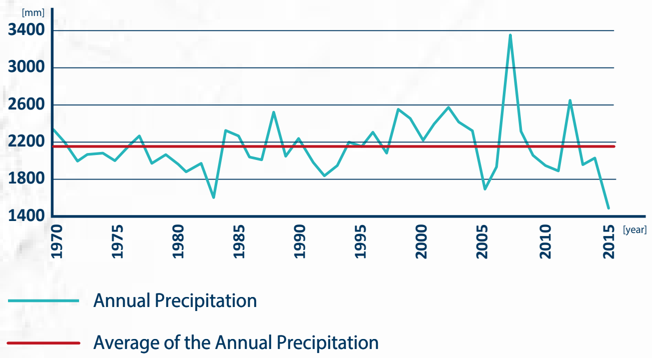
CLIMATE TRENDS

Similarly to other central African countries, temperature observations indicate that Equatorial Guinea has experienced a considerable increase in temperature over recent years.

An analysis of climate data from 1970 to 2015 [10] shows an average rise of around 1˚C. Trends for precipitation are not as clear as those for air temperatures, and are variable in time and space.

TEMPERATURE AND PRECIPITATION TRENDS IN CURRENT CLIMATE





RIVERS OF EQUATORIAL GUINEA

The main rivers are the Mbini, the Ntem and the Muni. The Mbini is the longest river with a length of 248 km. It runs from the east to the west, dividing the mainland in two. It is not navigable, except for a short stretch of about 20 km. The Ntem flows along part of the northern border with Cameroon. The Muni is not really a river but an estuary of several rivers, of which the Utamboni is the most notable. The islands contain several streams and brooks that are mostly filled by rainwater [11].

Photo Credit: The Mbini Estuary - By Nasa - Worldwind, Public Domain https://commons.wikimedia.org/w/index.php?curid=73801074

CLIMATE PROJECTIONS FOR EQUATORIAL GUINEA

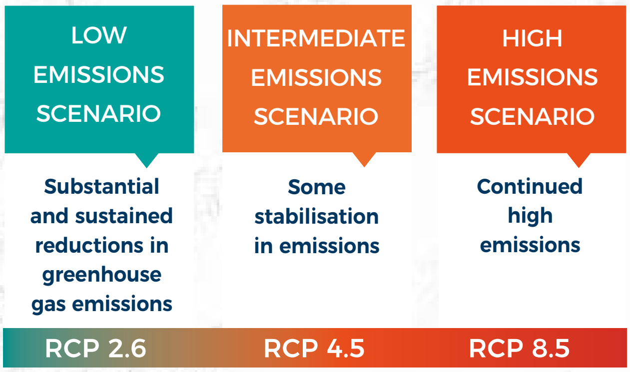
Climate projection studies are abundant for multiple different time spans and with various scales. Climate models are tools that the scientific community uses to assess trends in weather conditions over long periods. In a recent study [12] Alder, et al., compared the observed temperature and precipitations of the 1980-2004 period with the estimations of a set of global climate models provided by the Coupled Model Intercomparison Project Phase 5 (CMIP5). Three future periods (2025-2049, 2050-2074 and 2071-2095) were then analyzed for different greenhouse emission scenarios (see IPCC's Emissions Scenarios). Model simulations showed an increase in temperature in all future projections and emission scenarios. The increase of temperature was more evident in high emissions scenarios and long term period projections. In high emission scenarios (RCP8.5), model projections show an increase between about 1.5˚C and 3.5˚C for the mid term period (2050-2074) and an increase between about 2˚C and 5˚C for the long term period (2071-2095). Future changes in precipitation are much more uncertain, however the models likely predict an increase in precipitation for both medium and long term periods and for all different emission scenarios.

Time Frame	Climate Projections (RCP 8.5 - High emission scenario)
Mid-term Future (2050-2074)	Increase in temperature from 1.5˚C to 3.5˚C uncertain variations in precipitation, with possible increase
Far Future (2071-2095)	Increase in temperature from 2˚C to 5˚C uncertain variations in precipitation, with possible increase

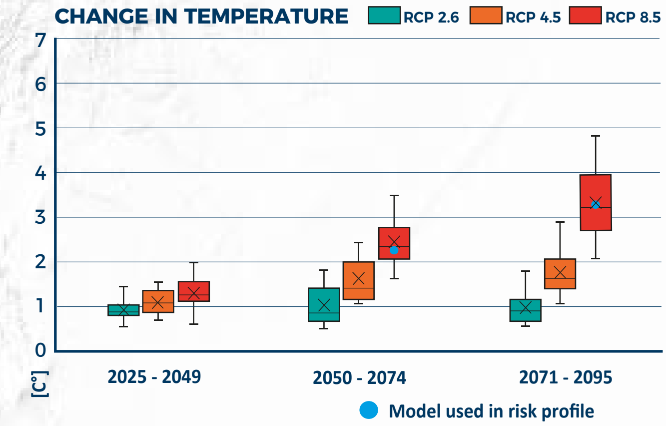
CLIMATE PROJECTIONS USED IN THIS RISK PROFILE

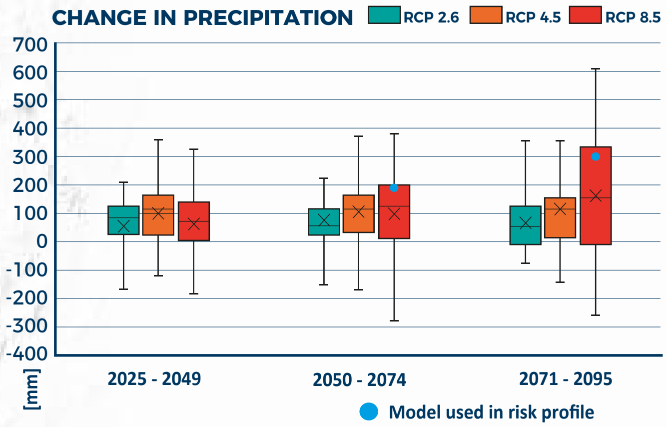
Results presented in the Risk Profile which refer to climate change have been obtained using a climate projection model based on a high emission scenario (SMHI-RCA4 model, grid spacing 0.44˚ about 50 km - driven by the ICHEC-EC-EARTH model, RCP 8.5, 2006-2100). [13, 14, 15]

This study uses a high-resolution model which has been accurately calibrated for the African domain. This allows for a better capture of climate variability which is key in assessing extremes. Regional model projections were checked for consistency against a full ensemble of global models available for the area. The regional model forecasts changes in temperature and annual precipitation, in line with the range of variability of global models analyzed in the study by Alder et al. [12].



IPCC's Emissions scenarios for Climate Projections

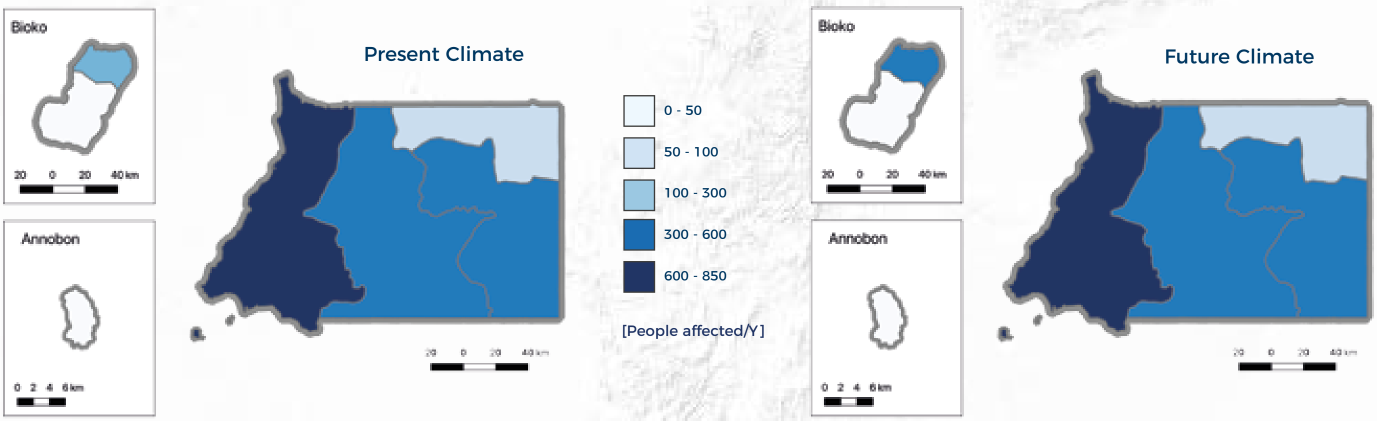




In the specific case of a high emission scenario, the regional model predicts an increase in temperature (almost 3.5˚C in the long term period) comparable to the mean value of the global ensemble. As regards to annual precipitation at the country level, the regional model predicted a precipitation increase of about 14% in the long term period, whereas the global ensemble predicts a precipitation average increase lower than 7% for the same period.

RESULTS | FLOODS

[B1] ANNUAL AVERAGE NUMBER OF AFFECTED PEOPLE



KEY MESSAGES

● Floods affect on average about 0.17% of the total population of the country. This percentage will likely increase up to 0.19% under future climate conditions.

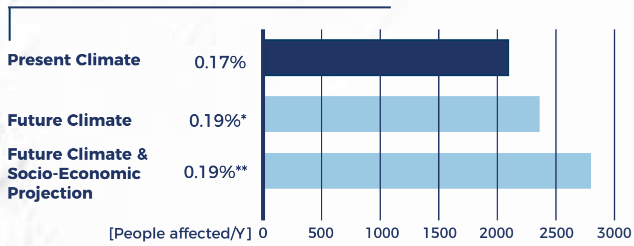
● The distribution of potentially affected people shows a hotspot in the Litoral province. Under future climate conditions, the north of the island of Bioko is also likely to become highly affected.

● The local economy is moderately exposed to floods. On a yearly average, the areas affected by floods produce about 0.14% of the national GDP which corresponds to about 16 Millions USD per year.

● It is likely that, under future climate conditions, the population affected shows a non-significant increase compared to the value evaluated under current climate conditions. However, as shown in the climate section, climate projections are inherently uncertain and this should be considered when using these estimations in policy development. Similar behavior is expected for the potentially affected GDP.

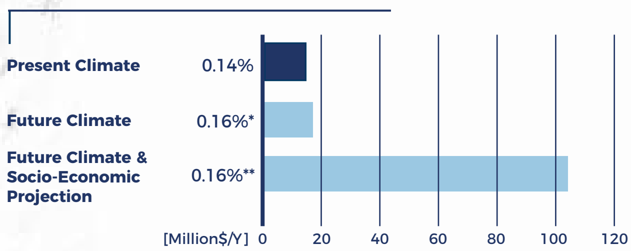
● When present conditions are compared with estimates of future climate conditions paired with the projected socio-economic situation (*), potentially affected population and areas where GDP is generated show a likely and significant increase. Specifically, affected population increases by 20% and potentially affected GDP increases up to 5 times with respect to estimates in the present climate. The future prediction is highly affected by uncertainty.

ANNUAL AVERAGE NUMBER OF POTENTIALLY AFFECTED PEOPLE [B1]



* % computed with reference to the total 2016 Population
** % computed with reference to the total 2050 Population

ANNUAL AVERAGE POTENTIALLY AFFECTED GDP

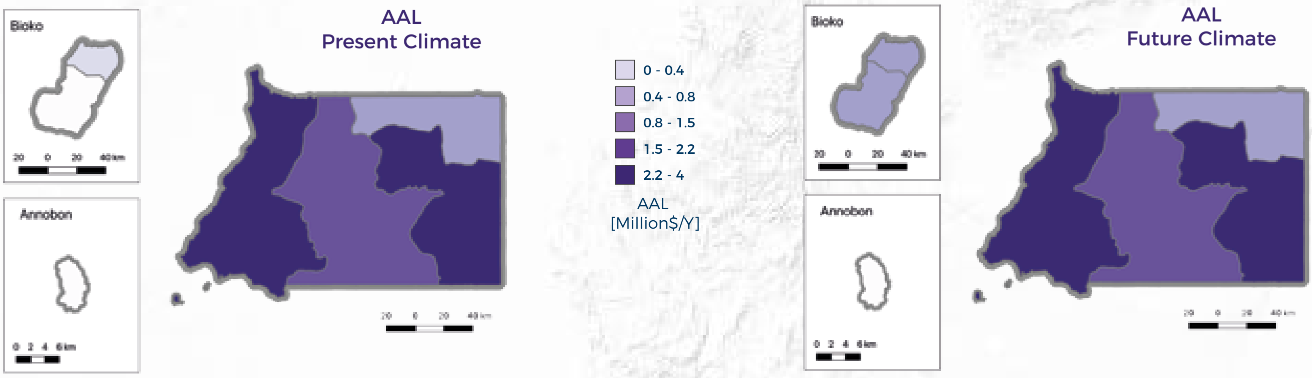


* % computed with reference to the total 2016 GDP
** % computed with reference to the total 2050 GDP

*2016 was taken as a reference year both for GDP and population.
**the Shared Socioeconomic Pathway (SSP) - "mid of the road" (Medium challenges to mitigation and adaptation) has been used to project population and GDP distributions.

RESULTS | FLOODS

[C1] DIRECT ECONOMIC LOSS



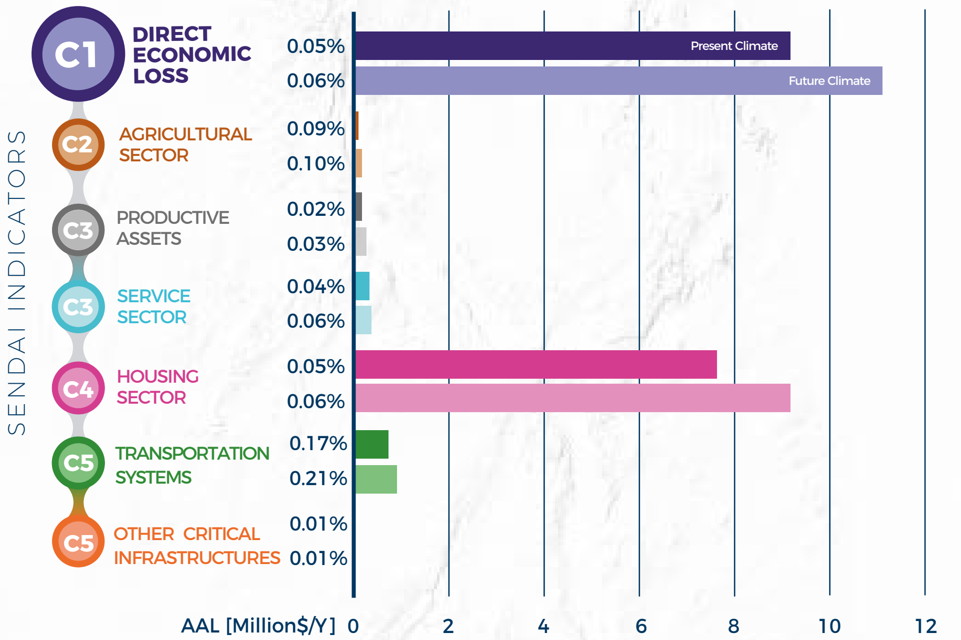
KEY MESSAGES

- The direct economic losses in Equatorial Guinea are the result of a complex combination of geographically distributed hazard and exposure. The Litoral and Wele-Nzas provinces are more significantly affected by floods. The pattern is markedly confirmed under future climate conditions, with an increase in the Bioko province.

- The value of direct economic losses in terms of AAL amounts to 9 million USD, roughly 0.05% of the total stock value in the present climate.

- The largest portion of losses is attributable to the housing sector followed by the transportation sector.

- Even considering the present value of assets, without socio-economic development, the direct economic loss shows an increase when climate change is considered. This increase is evenly observable across all sectors. The socio-economic projections are likely to increase this figure even more, depicting a worse risk scape for Equatorial Guinea in the future.



AFFECTED INFRASTRUCTURES [D4]

RESULTS | FLOODS

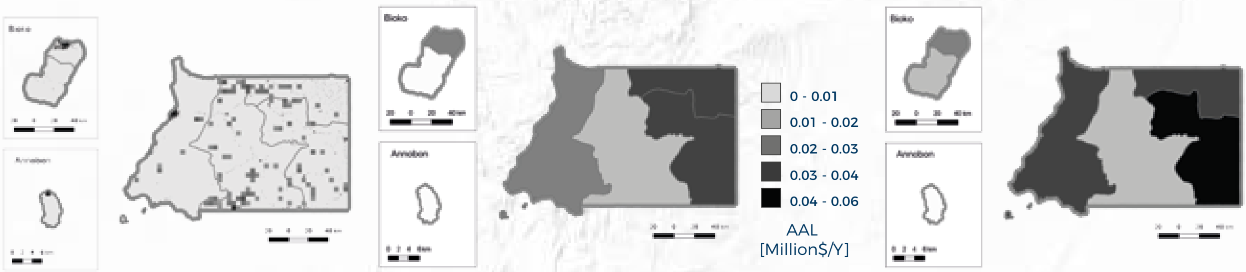
KEY MESSAGES

- The AAL distribution shows minor differences across the considered sectors depending on the exposure distribution. While the Litoral and Wele-Nzas remain the most impacted province the pattern of risk for the other provinces depends on the sector considered.

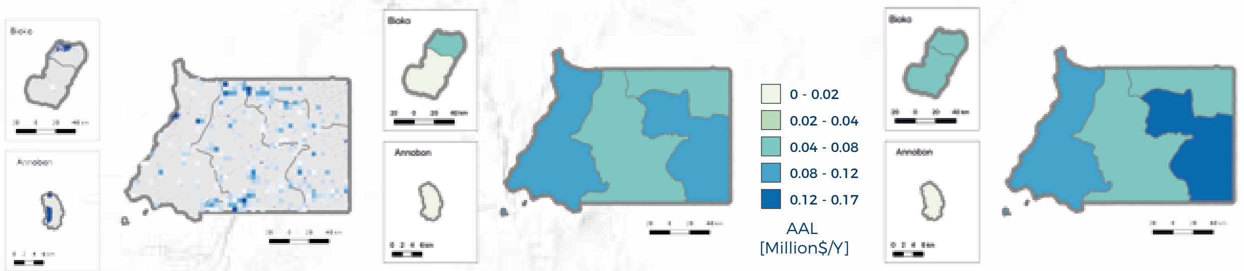
- Values of AALs for all sectors in the present are either confirmed or worsened under future climate conditions. For all sectors, AAL on the island of Bioko is expected to rise under future climate conditions.

EXPOSURE DISTRIBUTION | **AAL** - Present Climate | **AAL** - Future Climate

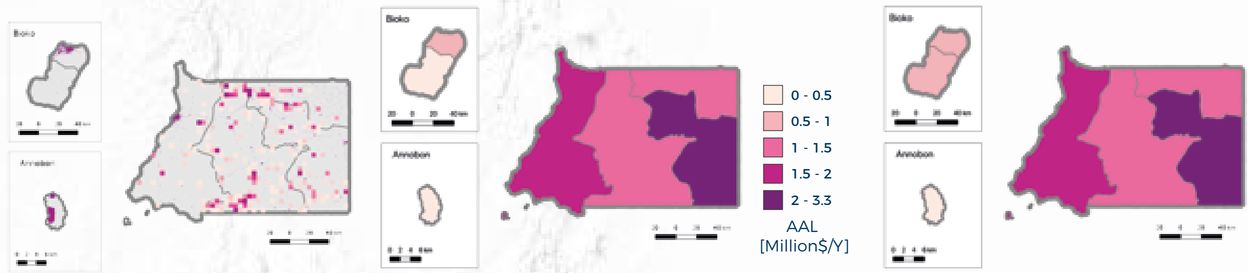
C3 PRODUCTIVE ASSETS



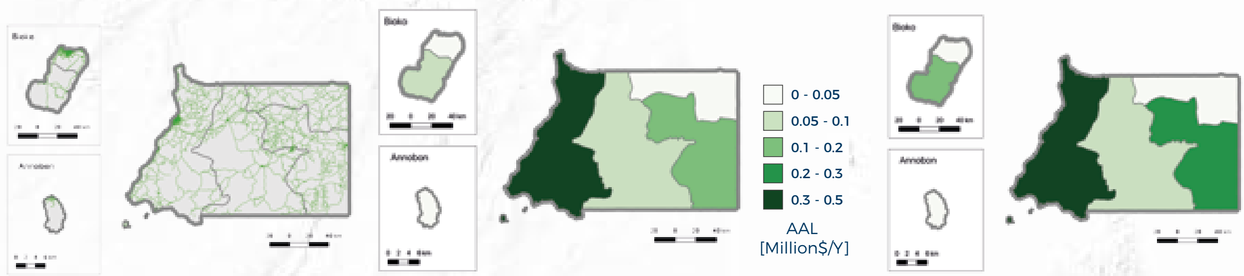
C3 SERVICE SECTOR



C4 HOUSING SECTOR



C5 TRANSPORT. SYSTEMS



RESULTS | FLOODS

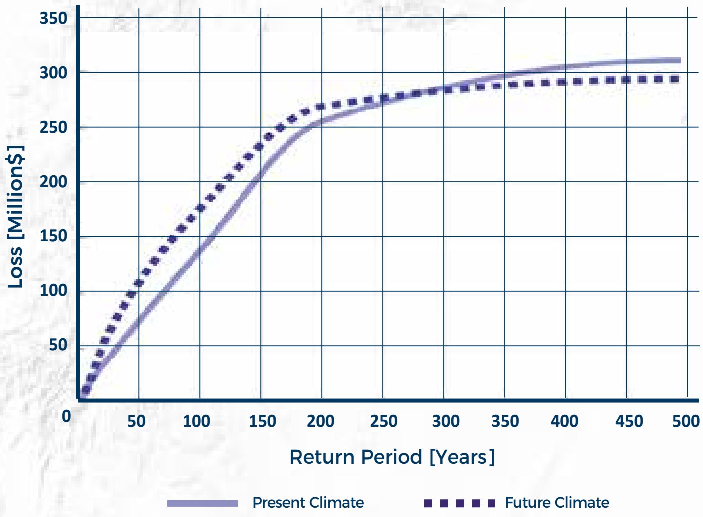
KEY MESSAGES

- PML curves rise steeply until the 150-year loss, meaning that considerable losses may be experienced relatively frequently. The specific shape of the PML curve shows that flood risk can be considerably reduced by strategically minimizing the impact of very frequent and frequent disaster events, hence by investing in disaster risk reduction.

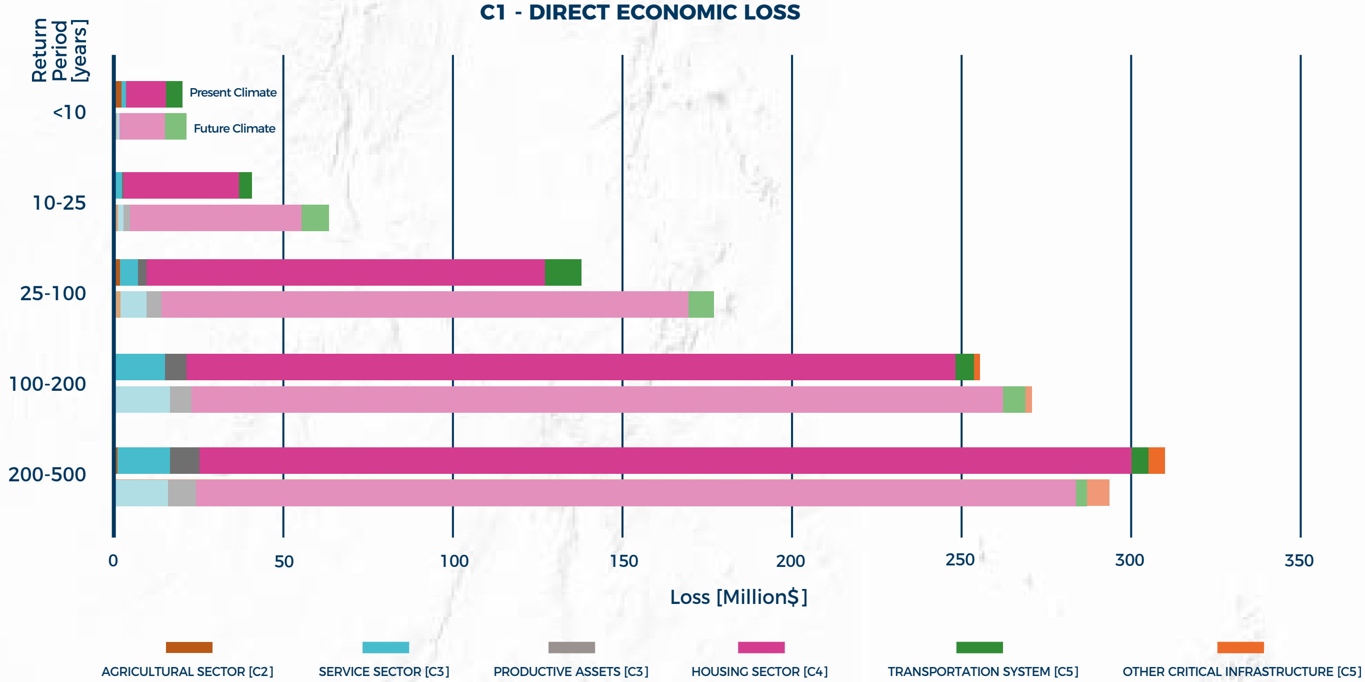
- It is likely that both frequent and rare flood-related losses will increase under future climate conditions and that greater differences will be observed until the 150-year loss.

- The sector that is by far the most affected by frequent, very frequent and extreme losses is the housing sector. The share for the service sector increases for rare events.

PROBABLE MAXIMUM LOSS CURVE (PML)
C1 - DIRECT ECONOMIC LOSS

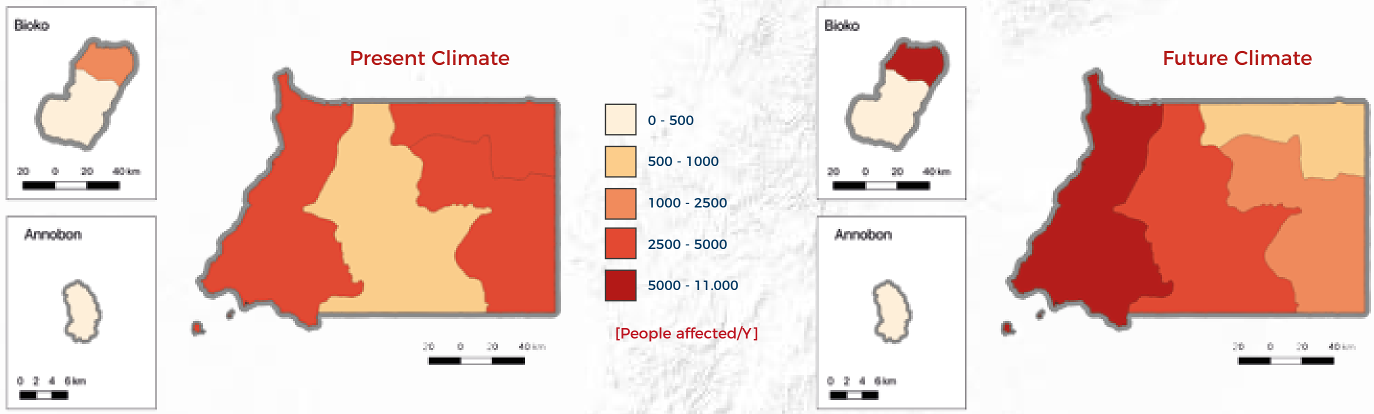


PROBABLE MAXIMUM LOSS CURVE (PML) ACROSS ALL SECTORS
C1 - DIRECT ECONOMIC LOSS



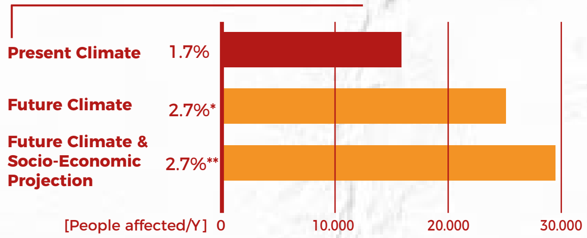
RESULTS | DROUGHTS

[B1] ANNUAL AVERAGE NUMBER OF AFFECTED PEOPLE



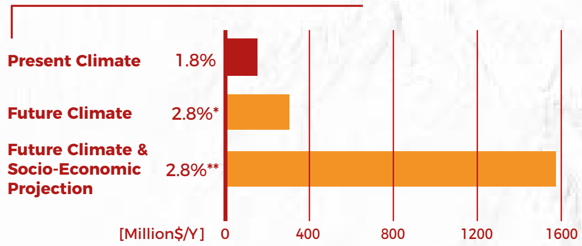
Annual average of population potentially affected by at least three months of drought conditions, as calculated using the standardized precipitation-evapotranspiration index (SPEI) and using a 3-month accumulation period.

ANNUAL AVERAGE NUMBER OF POTENTIALLY AFFECTED PEOPLE [B1]



* % computed with reference to the total 2016 Population
** % computed with reference to the total 2050 Population

ANNUAL AVERAGE POTENTIALLY AFFECTED GDP



* % computed with reference to the total 2016 GDP
** % computed with reference to the total 2050 GDP

KEY MESSAGES

- With respect to present conditions (1951-2000 climate), the probability of occurrence of severe drought (precipitation – evapotranspiration deficiency) will probably stay the same or may increase under future climate conditions (2050-2100 climate).

- Under present climate conditions, on average some 15.000 people (1.7% of the total 2016 Population) are annually affected by drought. Under future climate conditions, this number is expected to decrease by 2.7% (on average 29.000 people if population growth is accounted for).

- Under present climate conditions, 1.8% of the total GDP is generated in areas affected by drought. This is equivalent to about 165 million USD per year of potentially affected GDP. Under future climate conditions and considering the present exposure, the percentage of GDP in areas affected by drought is of around 2.8%. However, this could amount to around 1.6 billion USD, if socio-economic projections are included.

RESULTS | DROUGHTS

KEY MESSAGES

- Livestock is generally barely affected by current or future droughts.

- Under present climate conditions, average crop losses are dominated by five crops (banana, cassava, oil palm, plantain and sweet potato), and under the future climate (banana, oil palm and plantain) a significant physical loss has been calculated for only three crops. In relative units (compared to the average crop production), losses for all crops are very small in the present climate (<1%), and they decrease substantially under the selected future climate. For three crops, this even tends towards zero (cassava, root, and sweet potato).

- Direct economic crop production losses are concentrated in the eastern part of Equatorial Guinea under present climate conditions. Under future climate conditions, losses decrease substantially towards zero in most regions, except in Bioko Sur, where losses increase compared to the present climate.
The zero losses are the result of the higher production in the future climate, combined with a low future variation of the production, taking the situation of the present climate as a reference for defining crop losses. Given the high level of uncertainty in the future climate prediction, worse scenarios may also be possible (compare climate section on p.8).

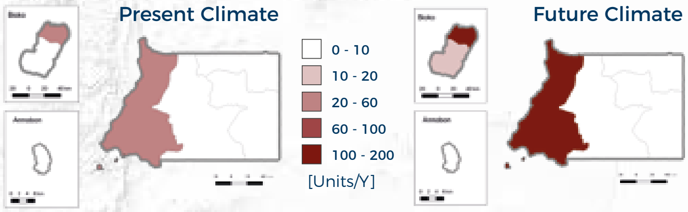
- Consistent with the decrease in crop production losses, the amount of lost working days also decreases between present and future climates. In total about 6000 (present) and 800 (future) working days are lost, which is about 0.05% and 0.01% of the average number of working days. However, the number of working days lost, expressed as a percentage of the average amount of days required for harvesting, is approximately eight times higher.

ANNUAL AVERAGE NUMBER OF POTENTIALLY AFFECTED LIVESTOCK UNITS* [Livestock units]

125 | 0.1% Present climate

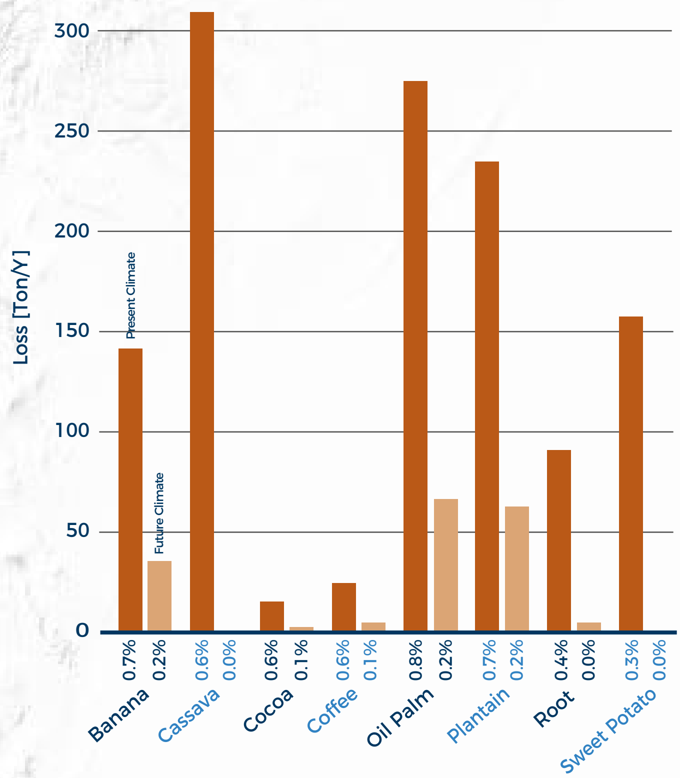
355 | 0.3% Future climate

*Livestock is a summation of all livestock animals (referred to as livestock units) using FAO conversion factors



Livestock units hit by more than 3 months of drought conditions, based on SPEI Index

AGRICULTURAL PRODUCTION LOSS

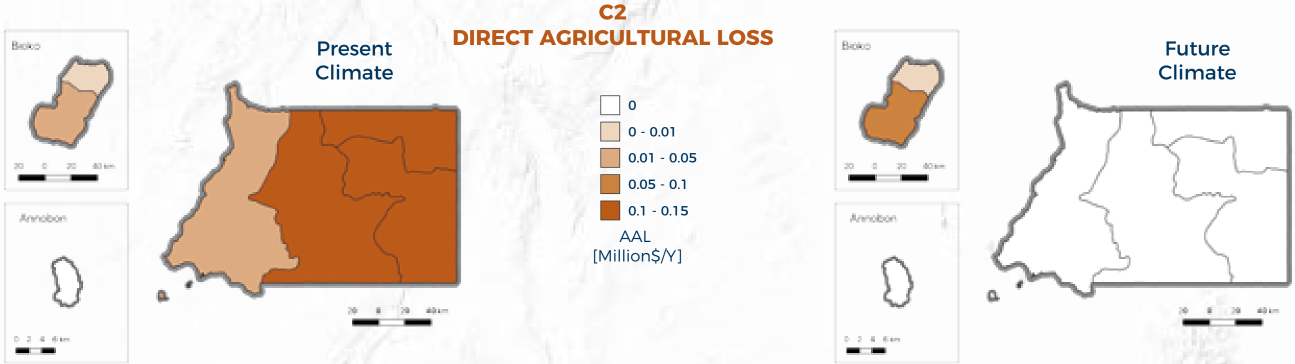


ANNUAL AVERAGE NUMBER OF WORKING DAYS LOST [Days]

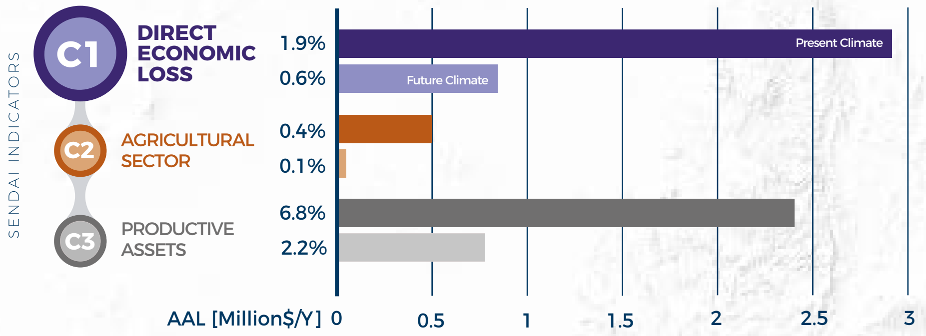
6000 | 0.05% Present climate

800 | 0.01% Future climate

C2 DIRECT AGRICULTURAL LOSS



RESULTS | DROUGHTS



C2 is computed considering only direct loss associated with reference agricultural (crop) production. Reference crops considered in the analysis are the ones which contribute to at least 85% of the total country-level gross crop production value. It might therefore happen that crops which have an important role in local commercial or subsistance agriculture can be neglected in the overall analysis.
C3 is computed considering exclusively losses in hydropower production. These are defined as production below levels with average reservoir conditions.

KEY MESSAGES

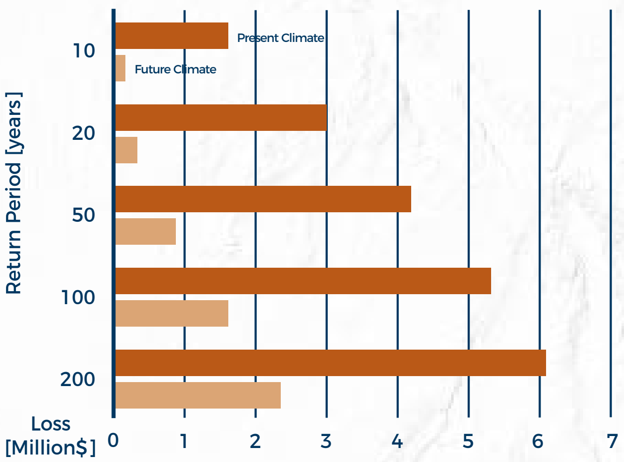
- Average annual economic crop production loss (C2) decreases from 0.5 million USD under present climate conditions to less than 0.1 million USD under future climate conditions. Losses in the present climate conditions represent 0.4% of the total average economic value of crop production, whereas in the future climate this declines to less than 0.1%.

- Average annual hydropower losses (defined as electricity production below average conditions) are expected to be reduced under future climate conditions (for Djibloho power station), from 7% to about 2% of annual production.

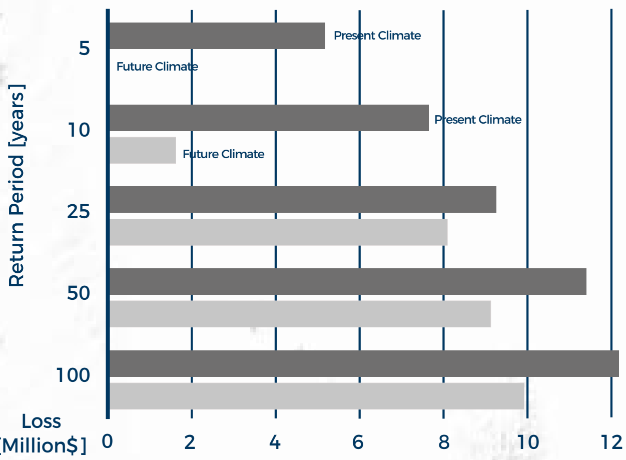
- Under current climate conditions, a gradual increase in agricultural (crop) income loss is expected when return periods go up from 10 years (loss of circa 1.5 million USD) to 200 years (loss of 6 million USD). Under future climate conditions, substantially lower losses are estimated for all return periods (up to 200 years). The most frequent loss (occurring on average once every 10 years) is diminished to almost zero under the selected future climate.

- The reduction in average annual hydropower losses is mainly the result of reduced losses for frequent events (1/5 and 1/10 years). Losses for more rare events (high return periods) are only slightly lower under future climate conditions.

PROBABLE MAXIMUM LOSS (PML)
C2 - AGRICULTURAL LOSS

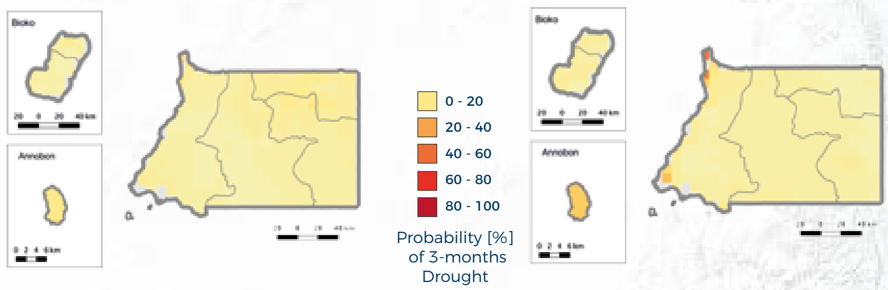


PROBABLE MAXIMUM LOSS (PML)
C3 - PRODUCTIVE ASSETS (HYDROPOWER LOSS)



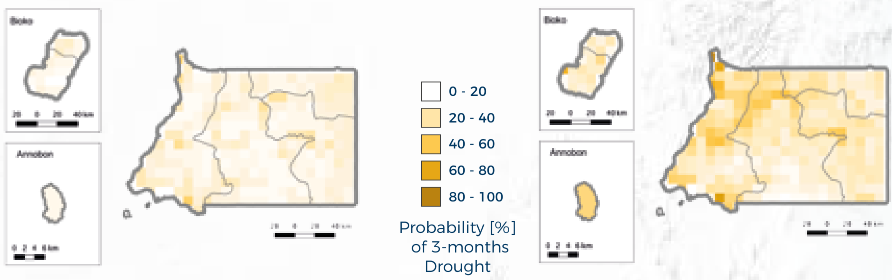
RESULTS | DROUGHTS

Present Climate | Future Climate



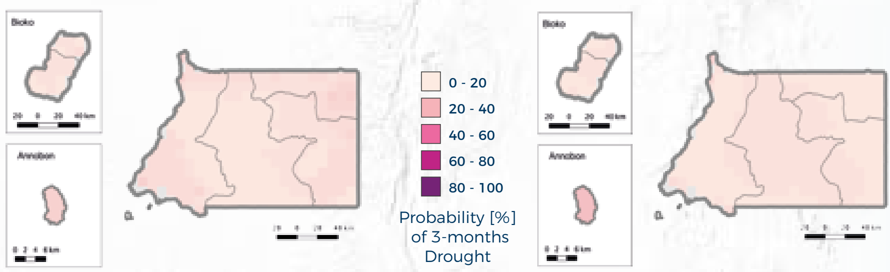
SPEI
Standardised Precipitation-Evapotranspiration Index

These maps denote the average annual chance of a meteorological drought occurring (%). Droughts are defined as 3 months of precipitation minus evapotranspiration values considerably below normal conditions; calculated through the Standardized Precipitation - Evapotranspiration Index (SPEI; see 'Drought' in Glossary).
It can be noted that currently, the probability of drought is very low. Along the coast, one can see an increase of droughts in the future climate. This is particularly important for areas dependent on rainfall for their water resources.



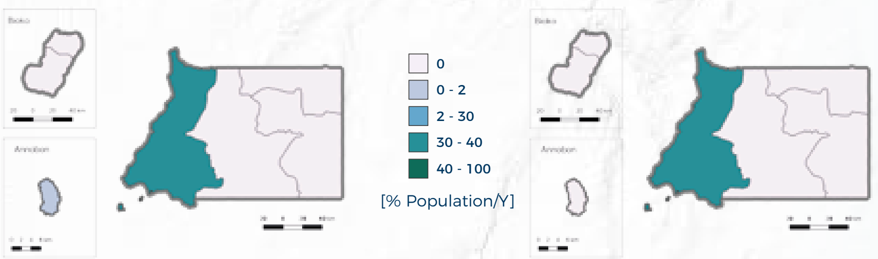
SSMI - Standardised Soil Moisture Index

These maps denote the average annual chance of a subsurface drought occurring (%). Droughts are defined as 3 months of soil moisture conditions considerably below normal conditions; calculated through the Standardized Soil Moisture Index (SSMI; see 'Drought' in Glossary).
In the north of the country and along the coast, the probability of droughts will increase the most. This is particularly important for agricultural and natural areas.



SPI - Standardised Precipitation Index

These maps denote the average annual chance of a meteorological drought occurring (%). Droughts are defined precipitation levels considerably below normal conditions, calculated through the Standardized Precipitation Index (SPI; see 'Drought' in Glossary).
It can be noted that the probability of droughts is low and does not change significantly in the future. This is particularly important for areas dependent on rainfall for their water resources.



WCI - Water Crowding Index

These maps show the percentage of the population per region experiencing water scarcity, based on the water available (precipitation minus evapotranspiration) per person per year (<1000 m³/person/year). Water scarcity indicates that a population depends on water resources from outside their immediate region (~85 km²).
Specifically, areas with high concentrations of people are dependent on outside water resources (Litoral province). Both under future and present climate conditions, this province is the most affected, in line with population concentration.

PROBABILISTIC RISK ASSESSMENT FOR RISK MANAGEMENT

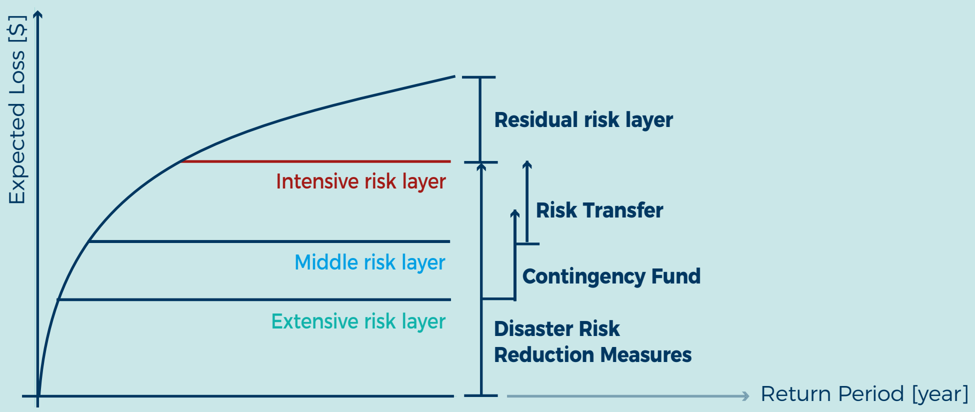
METRICS FOR RISK MANAGEMENT

Risk information may be used to put in place a broad range of activities to reduce risk. Such measures range from improving building codes and designing risk reduction measures, to undertaking macro-level risk assessments used to prioritise investments. Risk metrics help discern the risk contribution of different external factors (such as demographic growth, climate change, urbanization expansion, etc.). They also provide a net measure of progress in the implementation of disaster risk reduction policies. Average Annual Loss (AAL) can be interpreted as an opportunity cost. This is because resources set aside to cover disaster losses could be used for development. Monitoring AAL in relation to other country economic indicators – such as the GDP, capital stock, capital investment, reserves, and social expenditure – provides an indication of a country's fiscal resilience, broadly defined as holding internal and external savings to buffer against disaster shocks. Economies can be severely disrupted if there is a high ratio of AAL to the value of capital stock. Similarly, future economic growth can be compromised if there is a high ratio of AAL to capital investment and reserves. Social development will be challenged if there is a high ratio of AAL to social expenditure. Moreover, limited ability to recover quickly may significantly increase indirect disaster losses. Countries that already have compensatory mechanisms such as effective insurance in place and that can rapidly compensate for losses will recover far more quickly than those that do not. Such mechanisms may include insurance and reinsurance, catastrophe funds, contingency financing arrangements with multilateral finance institutions, and market-based solutions such as catastrophe bonds (UNDRR, 2011 and 2013).

The PML curve is particularly useful in order to articulate a full DRR strategy. It describes the loss that can be experienced for a given return period. Knowing the different level of losses expected on a certain frequency can help to understand how to organise a strategy combining different risk reduction, mitigation, or avoidance actions.

PML CURVE

The PML curve can be subdivided into three main layers. The Extensive Risk Layer is typically associated with risk reduction measures (e.g. flood defences, local vulnerability reduction interventions). The Mid Risk Layer captures cumulative losses from higher impact events. Losses within this layer are commonly mitigated using financial funds which are managed at the country level, such as the contingency fund. Losses which constitute the Intensive Risk Layer (severe and infrequent hazard events) are difficult to finance at the country level. Mechanisms of risk transfer are therefore required to address losses associated with this Intensive Risk layer (e.g. insurance and reinsurance measures). The remaining layer of the curve is Residual Risk (catastrophic events). It is the risk that is considered acceptable/tolerable due to the extreme rarity of such events and associated loss levels. Given its rarity, there are no concrete actions to reduce risk beyond preparedness (e.g. civil protection actions, humanitarian aid coordination).



GLOSSARY & REFERENCES

AFFECTED PEOPLE and GDP

Affected people are the ones that may experience short-term or long-term consequences to their lives, livelihoods or health and in the economic, physical, social, cultural and environmental assets. In the case of this report "affected people from Floods" are the people living in areas experiencing a flood intensity (i.e. a flood water level) above a certain threshold. Analogously, in this report "affected people from Droughts" are the people living in areas experiencing a drought intensity (i.e. a SPEI value) below a certain threshold. The GDP affected has been methodologically defined using the same thresholds both for floods and droughts.

CLIMATE MODEL*

A numerical representation of the climate system based on the physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for some of its known properties. Climate models are applied as a research tool to study and simulate the climate, and for operational purposes, including monthly, seasonal, and interannual climate predictions.

DISASTER RISK*

The potential loss of life, injury, or destroyed, or damaged assets which could occur to a system, society, or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability, and capacity.

DROUGHT

Droughts, defined as unusual and temporary deficits in water supply, are a persistent hazard, potentially impacting human and environment systems. Droughts, which can occur everywhere, should not be confused with aridity, a permanent climate condition. in this profile drought hazard is denoted by various indices, covering a range of drought types (meteorological, hydrological and soil moisture droughts) and standardised using seasonal data (i.e. values accumulated over 90 days). A drought is defined as at least three consecutive months with standardised index values below a certain drought threshold, indicating conditions that are significantly dryer than normal given the reference period 1951-2000.
This drought threshold varies between -0.5 and -2, according to the aridity index of that area: the dryer the area, the less extreme the water deficit needs to be be in order to be considered 'a drought'. droughts are analysed in terms of hazard, exposed population, livestock, and GDP. drought induced losses are explicitly estimated for crop production and hydropower generation.

FLOOD*

Flood hazard in the risk assessment includes river (fluvial) flooding and flash flooding. This risk profile document considers mainly fluvial flooding and flash floods in the main urban centres. Fluvial flooding is estimated at a resolution of 90 m using global meteorological datasets, a global hydrological model, a global flood-routing model, and an inundation downscaling routine. Flash flooding is estimated by deriving susceptibility indicators based on topographic and land use maps. Flood loss curves are developed to define the potential damage to the various assets based on the modelled inundation depth at each specific location.

LOSS DUE TO DROUGHT (CROPS)

Economic losses from selected crops result from multiplying gross production in physical terms by output prices at farm gate. Losses in working days have been estimated as function of crop-specific labour requirements for the cultivation of selected crops. Annual losses have been computed at Admin 1 level as the difference relative to a threshold, when an annual value is below this threshold. The threshold equals the 20% lowest value from the period 1951-2000 and has also been applied for the future climate. Losses at national level have been estimated as the sum of all Admin 1 losses.

RESIDUAL RISK*

The disaster risk that remains in unmanaged form, even when effective disaster risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained.

RESILIENCE*

The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management.

RETURN PERIOD*

Average frequency with which a particular event is expected to occur. It is usually expressed in years, such as 1 in X number of years. This does not mean that an event will occur once every X numbers of years, but is another way of expressing the exceedance probability: a 1 in 200 years event has 0.5% chance to occur or be exceeded every year.

**UNDRR terminology on Disaster Risk Reduction: https://www.unisdr.org/we/inform/publications/7817*

GLOSSARY & REFERENCES

RISK*
The combination of the probability of an event and its negative consequences. While in popular usage the emphasis is usually placed on the concept of chance or possibility, in technical terms the emphasis is on consequences, calculated in terms of "potential losses" for some particular cause, place, and period. It can be noted that people do not necessarily share the same perception of the significance and underlying causes of different risks.

RISK TRANSFER*
The process of formally or informally shifting the financial consequences of particular risks from one party to another, whereby a household, community, enterprise, or State authority will obtain resources from the other party after a disaster occurs, in exchange for ongoing or compensatory social or financial benefits provided to that other party.

**UNDRR terminology on Disaster Risk Reduction: https://www.unisdr.org/we/inform/publications/7817*

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[2] BBC Equatorial Guinea country profile https://www.bbc.com/news/world-africa-13317174

[3] http://www.worldometers.info/world-population/equatorial-guinea-population/

[4] Keywan Riahi et al., The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview, Global Environmental Change, Volume 42, January 2017, Pages 153-168

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The results presented in this report have been elaborated to the best of our ability, optimising the publicly data and information available. All geographic information has limitations due to scale, resolution, data and interpretation of the original sources.

www.preventionweb.net/resilient-africa

www.undrr.org

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riskprofilesundrr.org

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