2019

DISASTER RISK PROFILE

Flood Drought

Guinea Bissau

Building Disaster Resilience in Sub-Saharan Africa

An initiative of the African, Caribbean and Pacific Group of States funded by the European Union

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

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cima RESEARCH FOUNDATION

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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.

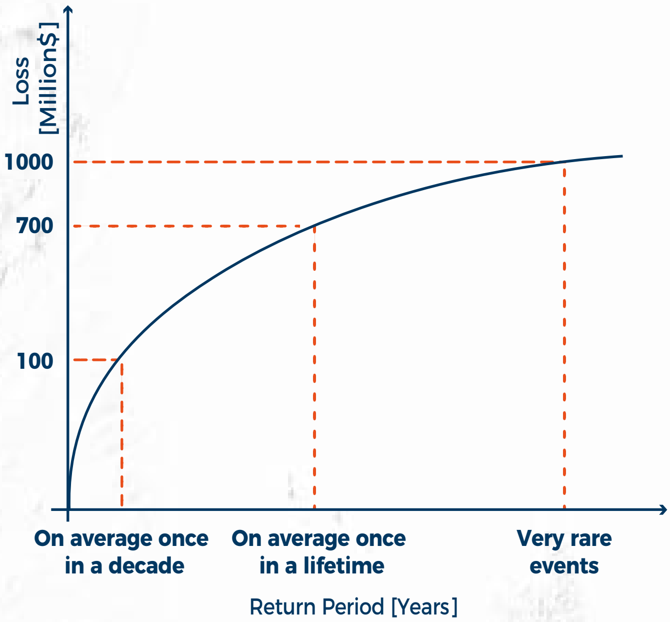
This disaster risk profile for floods and droughts is based on probabilistic risk assessment. Awareness of possible perils that may threaten human lives primarily derives from experience of past events. In theory, series of historical loss data long enough to be representative of all possible disastrous 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).

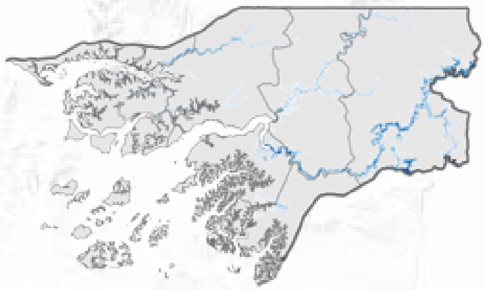


PROBABILISTIC RISK PROFILE: RISK COMPONENTS

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

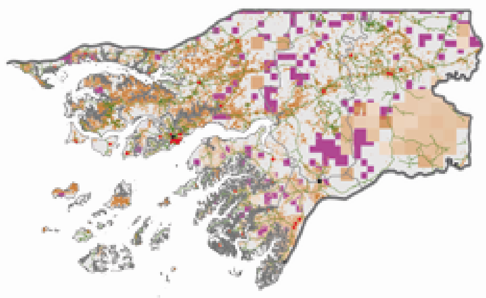
conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

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.

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

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

COUNTRY SOCIO-ECONOMIC OUTLOOK

OVERVIEW

The Republic of Guinea-Bissau, is one of the smallest West African nation-states. Bordered by Senegal to the north, Guinea to the south and east, and the Atlantic Ocean to the west, Guinea-Bissau has a growing and young population, with a median age of 19 years old. In 2016, the population of Guinea Bissau was estimated at 1.8 million, of which 43.4% were urban, mainly concentrated in the capital city Bissau [1]. Agriculture is the engine of Guinea-Bissau's economy.

The sector relies mainly on cashew nuts, rice, and the subsistence production of food crops. Cashews represent 90 percent of the country's exports and the principal source of income in rural areas [2]. Guinea-Bissau's economy has continued to expand in recent years. In 2017 economic growth reached 5.9%, largely reflecting high international cashew prices and good cashew production. However, economic activity slowed down in 2018 due mainly to lower cashew production, caused by adverse weather, and declining cashew prices. According the World Bank projections, real GDP growth in Guinea-Bissau is expected to gradually rebound to about 5.2% by 2020. This projection assumes relatively high cashew prices, improvements in electricity supply, and increased investment in road and other key infrastructure. Inflation is expected to rise slightly in view of higher global oil prices and rising domestic demand, but it should remain below 3% over the medium-term [3]. But in planning for future development, the non-negligible impacts of climate change need to be considered. The flooding and drought risk assessments presented in this report show the various potential 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 Guinea Bissau will increase by 37% between 2016 and 2050 (World Bank Data), whereas GDP is expected to increase more than thirteen-fold.

POPULATION

2016 Projection
1.8
[Million People]
2.5
2050 Projection

GDP

2016 Projection
1.1
[Billion$]
14.9
2050 Projection

GUINEA BISSAU

AREA : 36,125 km² *(STAT-GUINEBISSAU.COM)*

POPULATION DENSITY : 50 people/km²

MEDIAN AGE : 19 years

HDI - HUMAN DEVELOPMENT INDEX : 0.455 *(UNDP - 2017)*

LIFE EXPECTANCY AT BIRTH : 57.8 years *(UNDP - 2017)*

MEAN YEARS OF SCHOOLING : 3.0 years *(UNDP - 2017)*

EMPLOYMENT TO POP. RATIO (AGES > 15) : 67.3% *(WB - 2017)*

EMPLOYMENT IN AGRICULTURE : 83.5% *(WB - 2017)*

EMPLOYMENT IN SERVICES : 9.6% *(WB - 2017)*

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

COUNTRY CLIMATE OUTLOOK

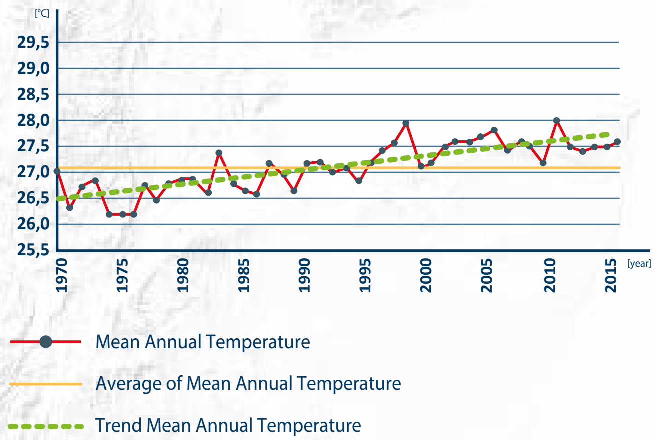
OVERVIEW

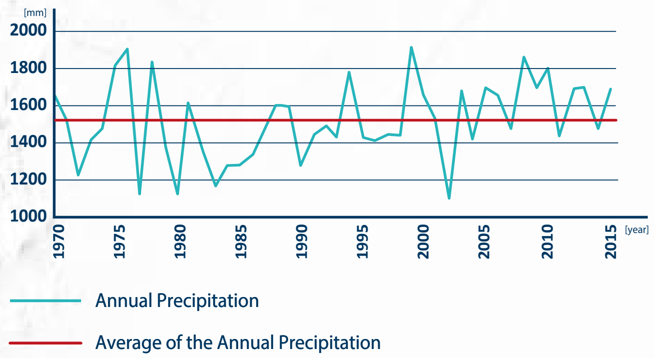
The climate divides the country into three ecological zones. The north-east is characterized by two distinct seasons: a dry season between November and May, and a rainy season from June to October. The south-east, characterized by a humid tropical climate, with more precipitation and which is less hot. The north-west of the country has a Guinean maritime climate, moderately rainy and warm [7]. Average annual precipitation for Guinea Bissau is approximately 1519 mm, while the mean number of wet days is 98.

CLIMATE TRENDS

As for other western and central African countries, temperature observations indicate that Guinea Bissau has experienced a considerable increase in temperature over the past five decades. An analysis of climate data from 1970 to 2015 [8] shows a rise of about 1˚C. Trends for precipitation are not as clear as those for air temperature, with high variability in time and space.

TEMPERATURE AND PRECIPITATION TRENDS IN CURRENT CLIMATE





RIVERS OF GUINEA BISSAU

There are six main rivers in Guinea Bissau. The first, the Cacheu, flows near the northern border with Senegal and is also known as Farim for part of its course. The Mansôa flows from the centre of the country and dumps into the Atlantic Ocean near the city of Bissau. The Gêba originates in Senegal and bisects the country. The Corubal originates in Guinea and meanders close to the southern border. On the southern border with Guinea is the Cacine. The last of the major rivers is the Rio Grande. These rivers provide the principal means of Transportation in the country. Along them, ocean-going vessels of hallow draught can reach most of the main towns, and flat-bottomed tugs and barges can reach most of the smaller settlements, except for those in the northeast [9].

Photo Credit: https://commons.wikimedia.org/wiki/File:Rio_Farim-Cacheu,_S%C3%A3o_Vicente,_Guinea-Bissau_(9089335316).jpg

CLIMATE PROJECTIONS FOR GUINEA BISSAU

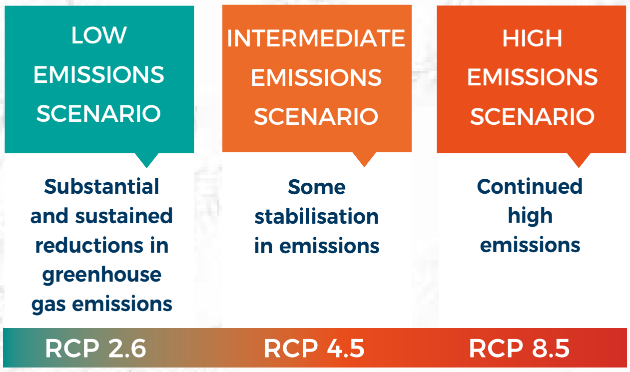
Climate projection studies are abundant for multiple different time spans and with various scales. Climate models are tools that the scientific community uses to assess trends in weather conditions over long periods. In a recent study [10] Alder, et al., compared the observed temperature and precipitations 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). In all future projections and emission scenarios, model simulations show an increase in temperature. The increase is more evident in high emission scenarios and long-term period projections. In high emission scenarios (RCP8.5), model projections showed an increase of between 1.5°C and 4°C for the midterm (2050-2074) and of between 2°C and 5.5°C for the long term (2071-2095). Future changes in precipitation are much more uncertain. Several models predict a decrease in precipitation for both the medium and long term and for all different emission scenarios, but a non negligible number predict an increase not showing consensus on the precipitation trend.

Time Frame	Climate Projections (RCP 8.5 - High emission scenario)
Mid-term Future (2050-2074)	Increase in temperature from 1.5°C to 4°C divergent change in precipitation from -10% to +7%
Far Future (2071-2095)	Increase in temperature from 2°C to 5.5°C divergent change in precipitation from -12% to +7%

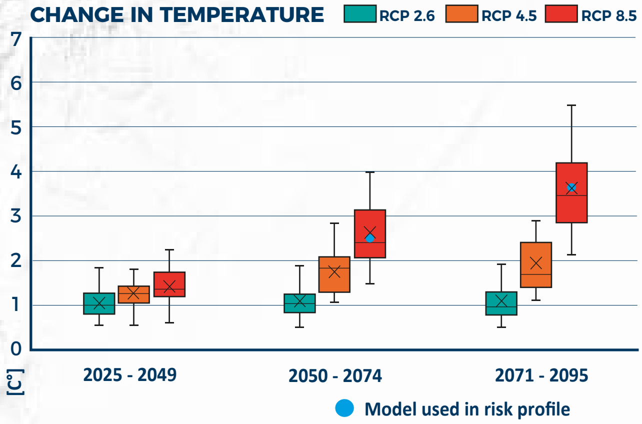
CLIMATE PROJECTIONS USED IN THIS RISK PROFILE

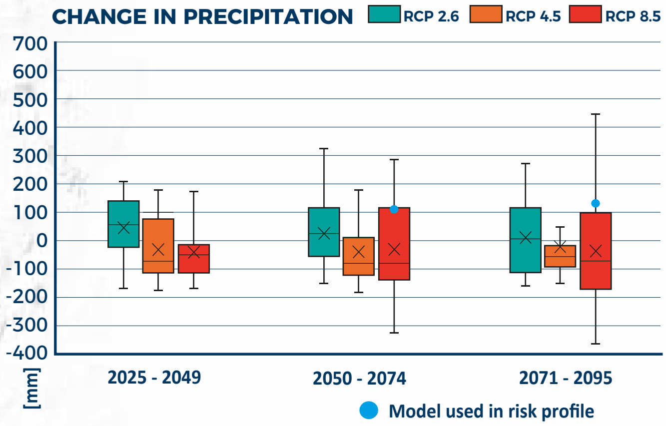
Results presented in the risk profile regarding climate change effects have been obtained using a regional climate projection model based on a high emission scenario (SMHI-RCA4 model, grid spacing 0.44° about 50 km- driven by the ICHEC-EC-EARTH model, RCP 8.5, 2006-2100) [11, 12, 13].

This high resolution model has been accurately calibrated for the African domain. This allows for a better capture of local climate variability which is key in assessing extremes. Regional model projections were also checked for consistency against a full ensemble of global models available for the area. Projected changes in temperature and annual precipitation from the regional model are in line with the range of variability of global models analyzed in the study by Alder et al. [10].



IPCC's Emissions scenarios for Climate Projections

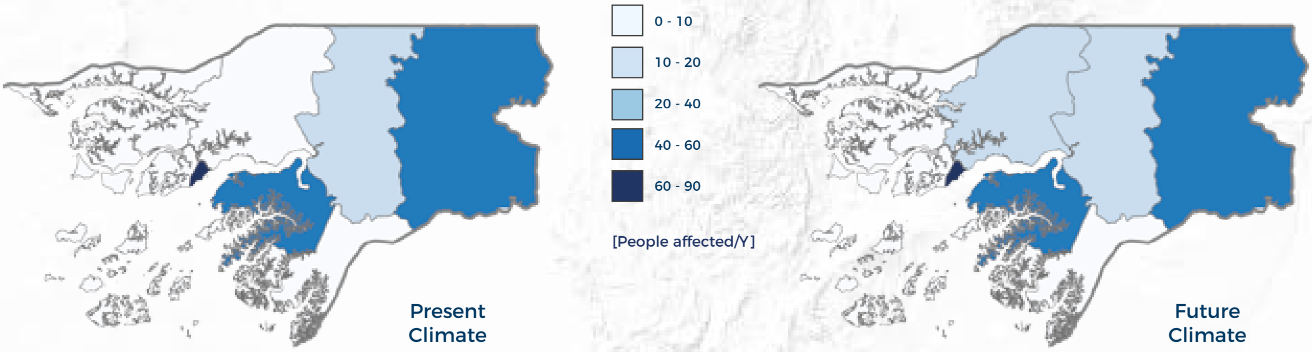




In the specific case of high emission scenario, the regional model predicts an increase in temperature that is in line with the ensemble average (slightly more than 3.5°C in the long term period). As regards to annual precipitation at the country level, the regional model run predicts a precipitation increase that is at the upper limit of the interquartile range of the global model's ensemble.

RESULTS | FLOODS

[B1] ANNUAL AVERAGE NUMBER OF AFFECTED PEOPLE



KEY MESSAGES

● Flooding affects on average almost 200 people per year in Guinea Bissau.

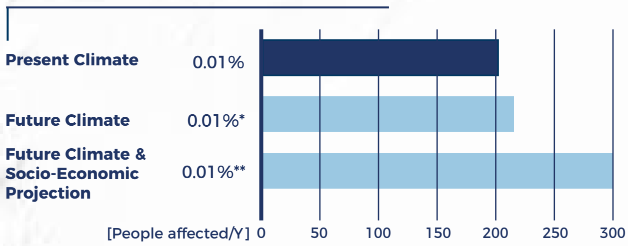
● The majority of the affected people are concentrated in the south-western part of the country, in the Quinara province.

● The local economy is also exposed to floods. Annually, on average, about 2 million USD of GDP is potentially affected by floods. This corresponds to about 0.16% of the total annual GDP at the country level.

● Under future climate conditions, considering that climate models predict a significant increase in temperature and a contradicting behaviour for precipitation, the flood-affected population and potentially flood-affected GDP are likely to show a non-significant increase. However, climate projections remain inherently uncertain and caution is required when considering the above estimations in policy making.

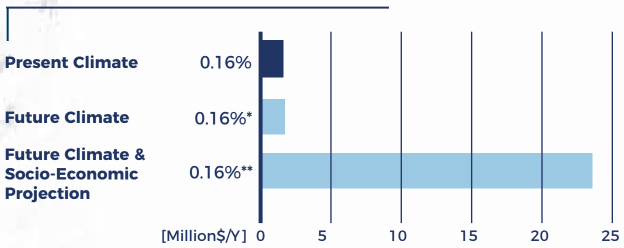
● A significant increase in flood-affected population and GDP is predicted when future climate conditions are paired with socio-economic projections (*). Namely, the flood-affected population increases by about 30% under future conditions and flood-affected GDP increases 10 times. This is the result of a disproportionate projected GDP growth**. Nevertheless, future predictions remain highly uncertain.

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

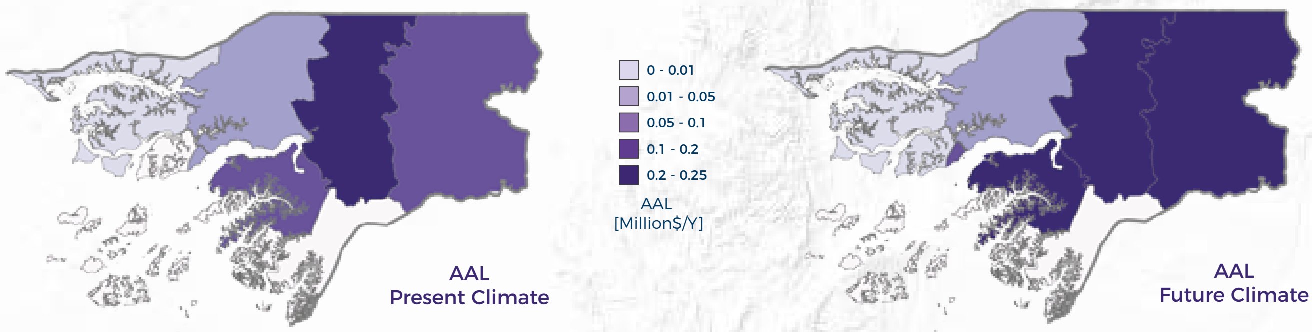


* % computed with reference to the total 2016 GDP
** % computed with reference to the total 2050 GDP

*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



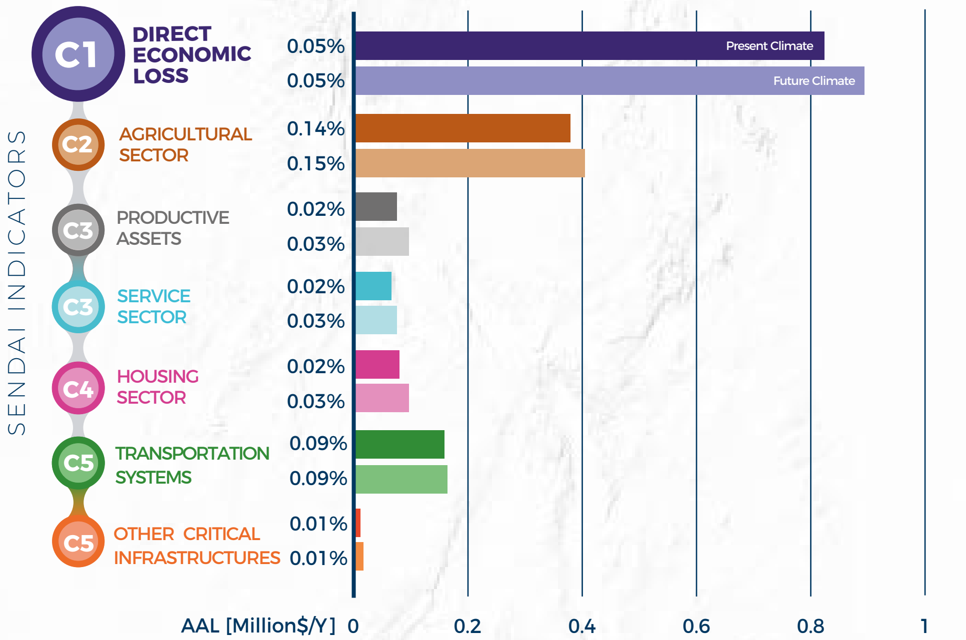
KEY MESSAGES

● Direct economic losses in Guinea Bissau show a different pattern when compared with the flood-affected population. Bafatà and Gabù provinces show the highest losses. This pattern is confirmed in future climate conditions. Additionally values increase in the southwestern part of the country.

● Direct annual economic losses amount to a bit more than 800.000 USD, which accounts to roughly 0.05 % of the total stock value under present climate conditions. The losses are dominated by the agriculture and transport sectors.

● Considering the present exposed assets for all sectors, it is likely that average annual losses will increase slightly under future climate conditions. This estimation does not consider socio-economic projections that can possibly aggravate the future projections.

● The proportion of different sectors in the overall loss does not change under future climate conditions. As highlighted above, climate projections are inherently uncertain and this should be considered when using these estimations in policy development.



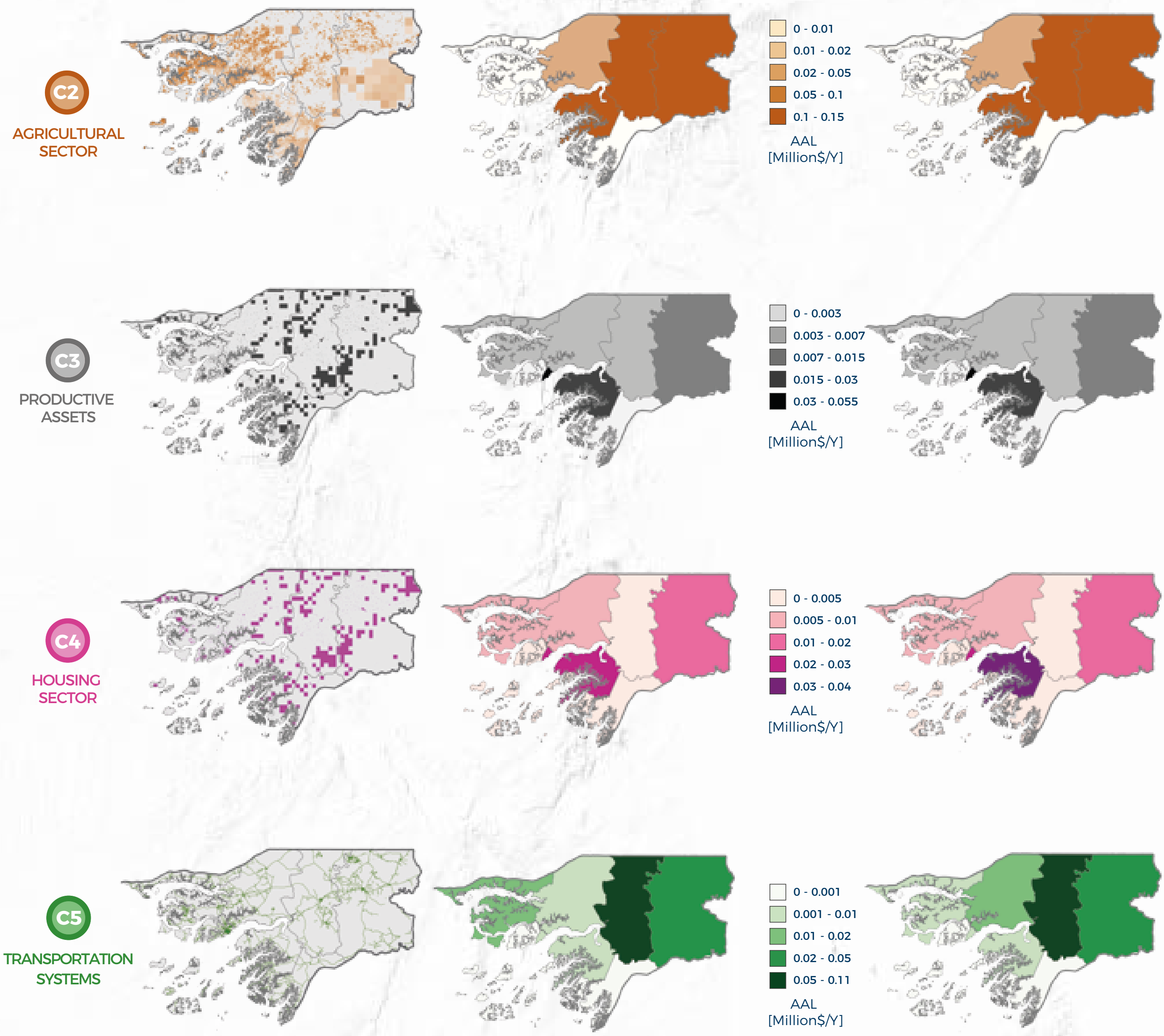
AFFECTED INFRASTRUCTURES [D4]

RESULTS | FLOODS

KEY MESSAGES

- The AAL distribution shows differences across each of the sectors considered. While Quinara and Bissau are the most impacted regions regarding the housing and industrial sectors, the central-eastern part of the country shows the largest losses in agriculture and transport.
- Comparison of AALs for all sectors between present and future climate conditions shows that an increase of economic losses can be expected. The pattern indicating an increase in economic losses is confirmed in all sectors.

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



RESULTS | FLOODS

KEY MESSAGES

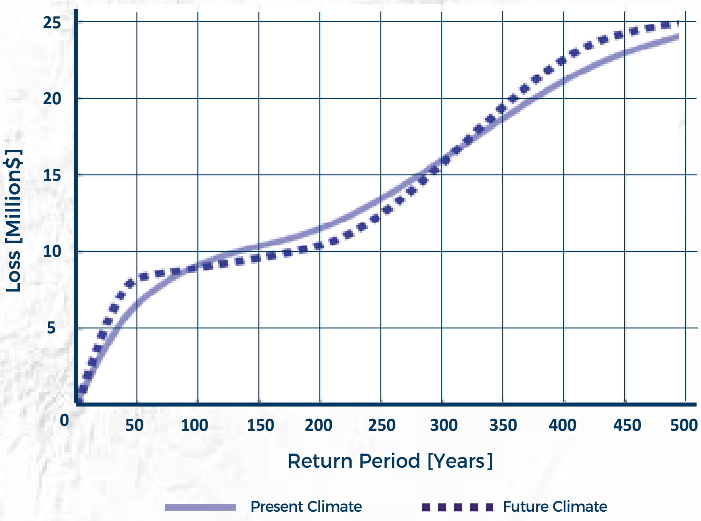
● Although the Average Annual Loss is of about 800.000 USD, the likelihood of a 5 million USD loss from floods is, on average, of one every 25 years. This means that considerable losses may be experienced frequently. The likelihood of disaster losses of about 8 million USD is of on average one in 100 years. Extremes losses might reach 25 million USD.

● The losses in the future climate will be higher for very frequent and very rare loss events. Losses will be comparable for other frequencies. Given the high level of uncertainty in the future climate prediction, worse scenarios may also be possible (compare climate section on p.8).

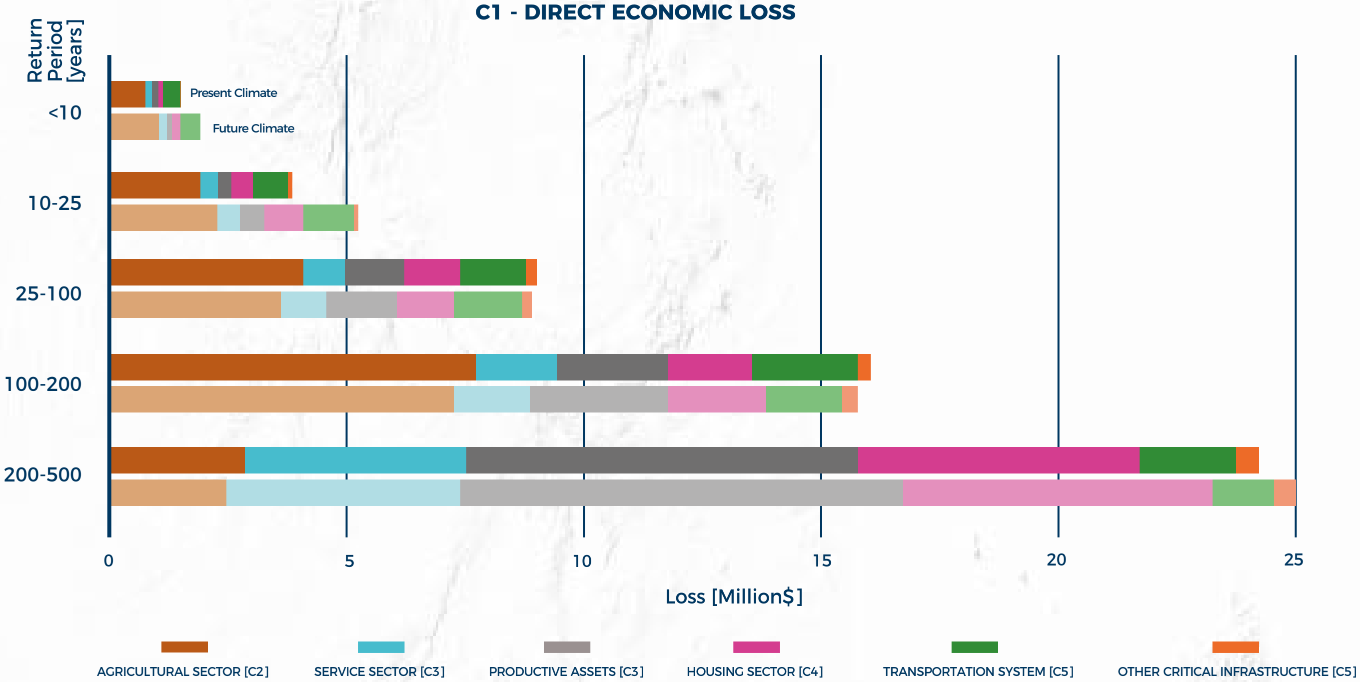
● While the transportation systems show a similar absolute value for all frequencies, the agricultural sector takes the lion's share in the case of rare loss events. Housing and productive sectors have the highest losses in the case of very rare loss events.

● 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.

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

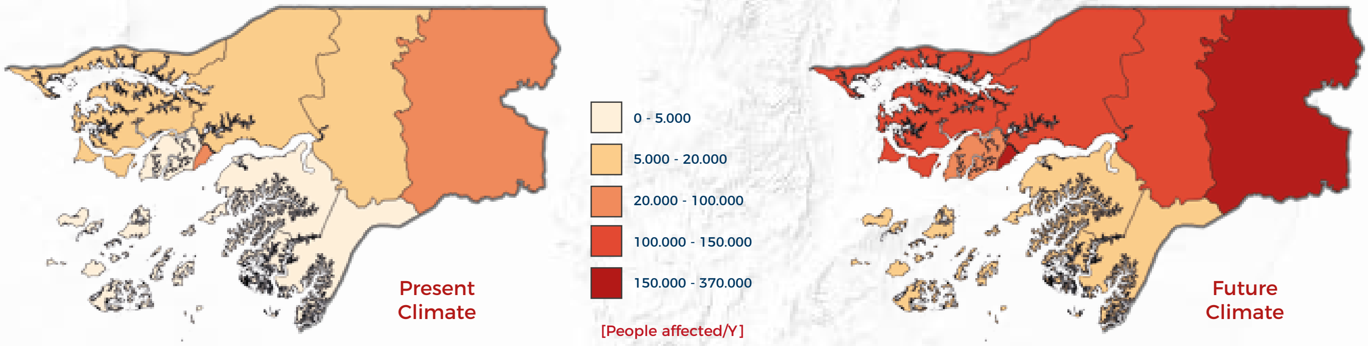


PROBABLE MAXIMUM LOSS CURVE (PML) ACROSS ALL SECTORS
C1 - DIRECT ECONOMIC LOSS



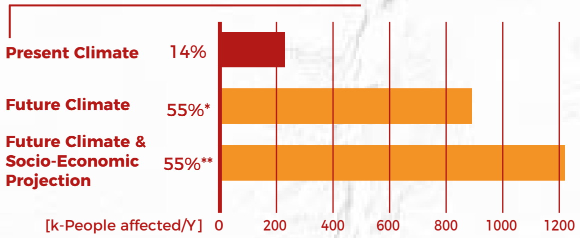
RESULTS | DROUGHTS

[B1] ANNUAL AVERAGE NUMBER OF AFFECTED PEOPLE



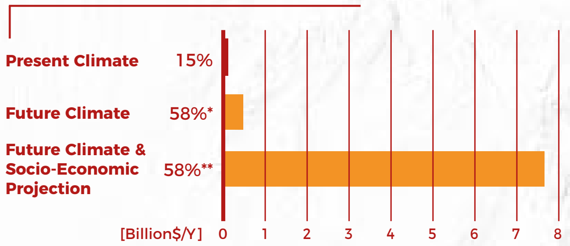
Annual average of population potentially affected by at least three months of drought conditions, as calculated using the standardized precipitation-evapotranspiration index (SPEI) and using a 3-month accumulation period.

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 for three months) will increase slightly in the future (2050-2100 climate). This increased drought hazard is country-wide but will mainly occur in areas which are currently already hard hit.

- Under present climate conditions, on average 252.000 people (14% of the total 2016 population) are annually affected by droughts. Under future climate conditions, this number is expected to increase to 1.3 million people if population growth is accounted for, mainly affecting the eastern part of the country.

- Under present climate conditions, the average annual percentage of drought-affected GDP (i.e. the economic value produced in areas hit by droughts) is of about 15% of the total GDP. This is equivalent to about 159 million USD per year which could be impacted by droughts. Under future climate conditions, drought-related losses may rise to 58% of the GDP, which could amount to more than 7.5 billion USD per year, if socio-economic projections are included.

RESULTS | DROUGHTS

KEY MESSAGES

- Under present climate conditions, affected livestock (i.e. animals living in areas hit by droughts) number 62.000 livestock units (14% of the livestock population). Under future climate conditions (but keeping the current amount of livestock), the number of affected livestock is projected to increase to more than 248.000 livestock units (56% of the total). Presently, most of the livestock affected by drought are in areas situated in the east of Guinea Bissau, whereas under future climate conditions, the rest of the country is also likely to see an increase in livestock affected by drought.

- Under both present and future climate conditions, crop losses are dominated by five crops (cashew, cassava, maize, rice and sorghum). Losses for three crops (maize, rice and sorghum) increase substantially in the future climate compared to the present climate, whereas those for bananas, cashews and cassavas decrease only slightly. The highest relative losses amount to almost 10% of the average crop production (sorghum under future climate conditions).

- Economic crop production losses are concentrated in two northern-central regions of Guinea Bissau (Oio and Bafatà). Under future climate conditions, losses will not change much in most parts of Guinea Bissau, except in Cacheu with an increase compared to the present climate conditions.

- The amount of lost working days amounts to 44.000 under present climate conditions, and increase to 57.000 in the future. Under present climate conditions, 0.22% of the average number of working days in crop cultivation are lost and this is predicted to increase to 0.28% in the future. However, the number of working days lost, expressed as a percentage of the average amount of days required for harvesting, is approximately 7 times higher.

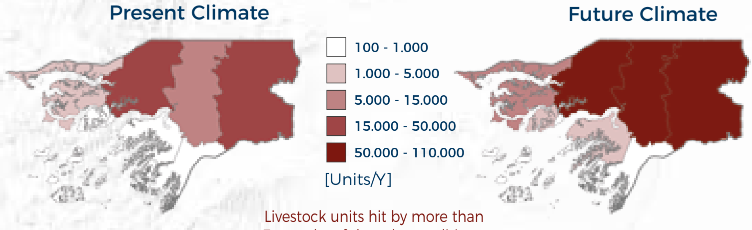
ANNUAL AVERAGE NUMBER OF WORKING DAYS LOST [k-Days]

44 Present climate | **0.22%**
57 Future climate | **0.28%**

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

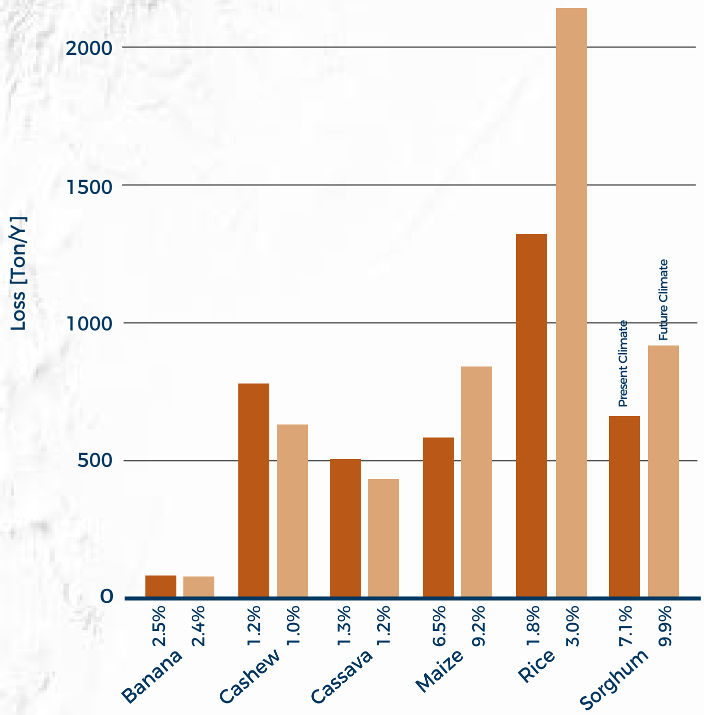
62 Present climate | **14%**
248 Future climate | **56%**

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

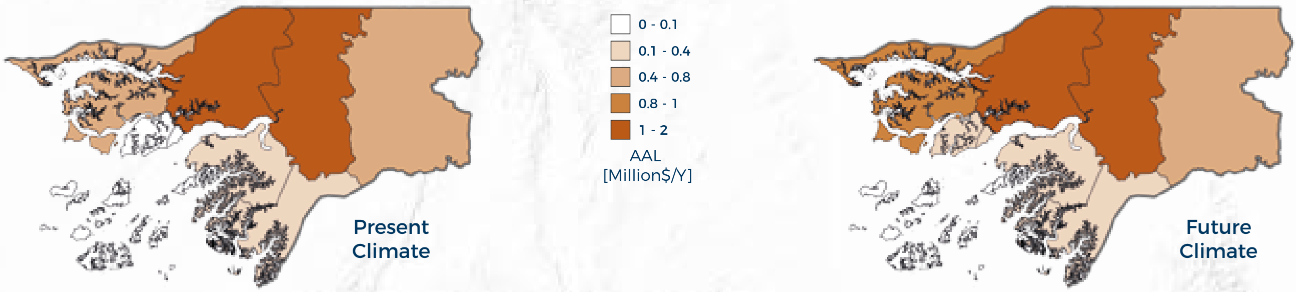


Livestock units hit by more than 3 months of drought conditions, based on SPEI Index

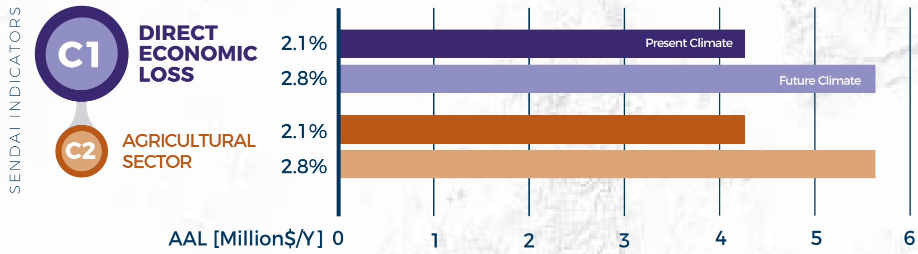
AGRICULTURAL PRODUCTION LOSS



C2 - DIRECT AGRICULTURAL LOSS



RESULTS | DROUGHTS

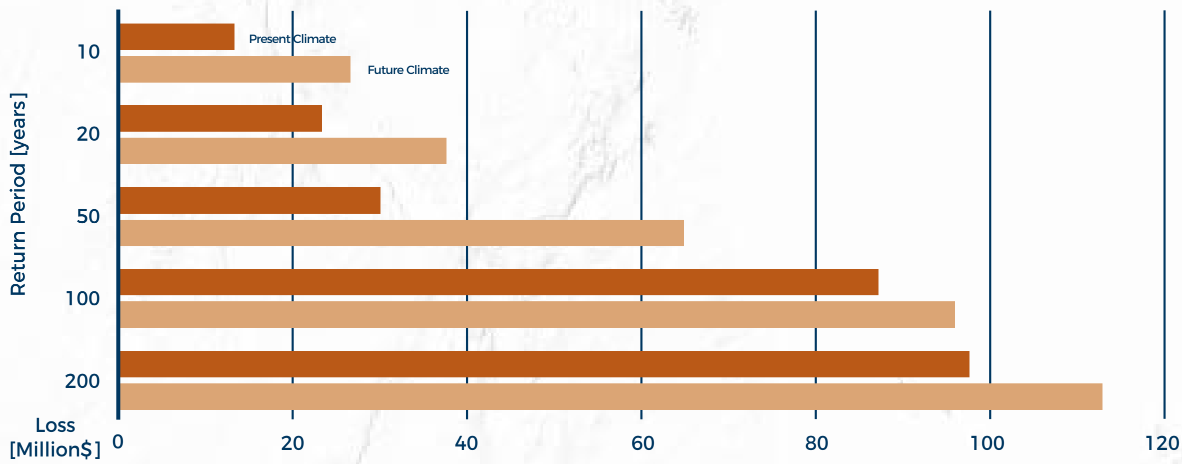


C2 is computed considering only direct loss associated with reference agricultural (crop) production. Reference crops considered in the analysis are the ones which contribute to at least 85% of the total country-level gross crop production value. It might therefore happen that crops which have an important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

KEY MESSAGES

- Average annual economic crop production loss (C2) increases from more than 4 million USD under present climate conditions to circa 5.5 million USD under future climate conditions . These losses represent 2.1% and 2.8% of the average economic value of crop production, respectively for present and future climate conditions.
- Under current climate conditions, a gradual increase in agricultural (crop) income loss is expected when return periods go up from 10 to 200 years. Under future climate conditions, higher losses are expected for all return periods, where more frequent losses (return periods of 10 to 50 years) increase relatively more than less frequent losses (return periods of 100 and 200 years), compared to present climate.

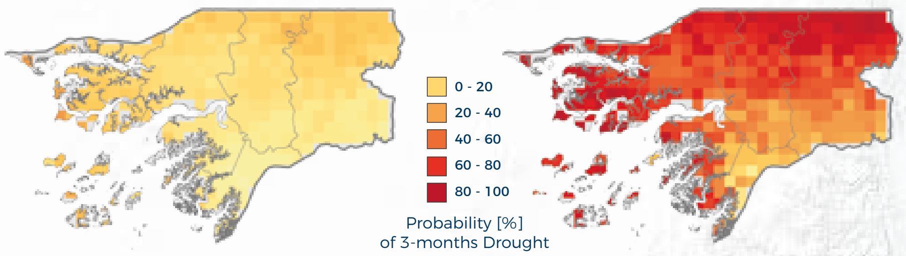
PROBABLE MAXIMUM LOSS (PML)
C2 - AGRICULTURAL LOSS



RESULTS | DROUGHTS

Present Climate

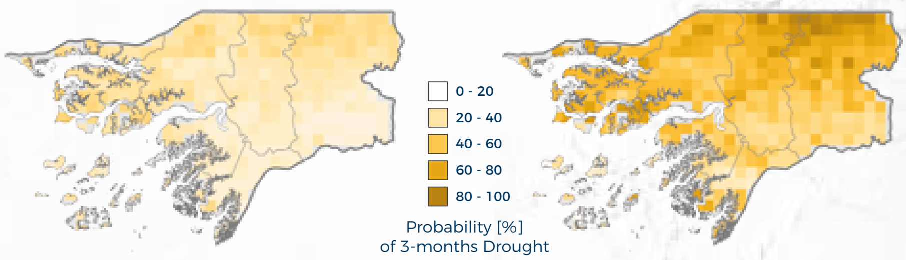
Future Climate



SPEI

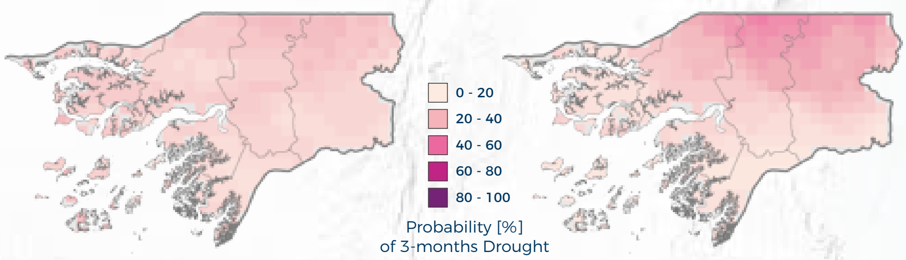
Standardised Precipitation-Evapotranspiration Index

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 droughts is the highest in the north of the country and along the coast. These places will also see the highest increase in droughts under future climate conditions. This is particularly important for areas dependent on rainfall for their water resources.



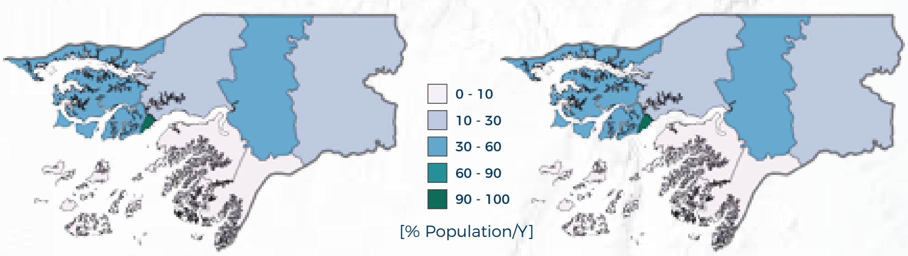
SSMI - Standardised Soil Moisture Index

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, the probability of soil moisture droughts will increase the most. This is particularly important for agricultural areas and nature.



SPI - Standardised Precipitation Index

These maps denote the average annual chance of a meteorological drought occurring (%). Droughts are defined as 3 months of precipitation levels considerably below normal conditions; calculated through the Standardized Precipitation Index (SPI; see 'Drought' in Glossary). The probability of droughts in the north is the most pronounced.
It can be noted that currently, the probability of droughts is the highest in the north of the country. These places will also see the highest increase in droughts in a future climate. 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 m^3/person/year). Water scarcity indicates that a population depends on water resources from outside their immediate region (~85 km^2).
The highest percentage of population under water scarcity can be found in the more populous areas of the country, for example around the coastline and capital, where more than half of the population is not self-sufficient in water.

PROBABILISTIC RISK ASSESSMENT FOR RISK MANAGEMENT

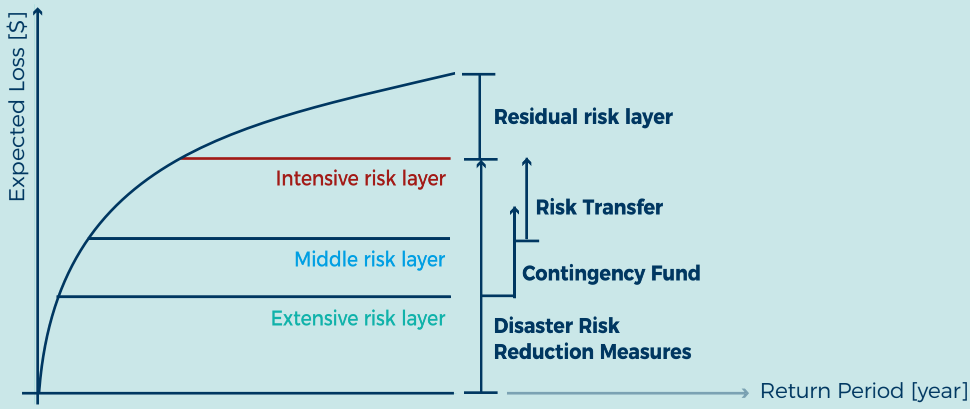
METRICS FOR RISK MANAGEMENT

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*

[1] http://worldpopulationreview.com/countries/guinea-bissau-population/

[2] https://mpra.ub.uni-muenchen.de/11181/1/MPRA_paper_11181.pdf

[3] http://www.stat-guinebissau.com

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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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