Federal Ministry
for Economic Cooperation
and Development

Climate Risk Profile: Mali

Summary

This profile provides an **overview of projected climate parameters and related impacts** on different sectors in Mali until 2080 **under different climate change scenarios** (called Representative Concentration Pathways, RCPs). RCP2.6 represents the low emissions scenario in line with the Paris Agreement; RCP6.0 represents a medium to high emissions scenario. **Model projections do not account for effects of future socioeconomic impacts.**

Agro-ecological zones might **shift, affecting ecosystems, biodiversity** and **crop production**. Models project regionally varying changes in species richness and an increase in tree cover in southern Mali.

Agriculture, biodiversity, health, infrastructure and water are highly vulnerable to climate change. The **need for adaptation in these sectors should be represented in the German development cooperation portfolio** in Mali.

Per capita water availability will decline by 2080 mostly due to population growth. Model projections indicate that **water saving measures will become particularly important after 2050 in south-western Mali.**

Depending on the scenario, **temperature** in Mali is projected to **rise by between 2.0 and 4.6 °C by 2080**, compared to pre-industrial levels, with higher temperature rises in northern Mali.

The **population affected by at least one heatwave per year** is projected to **rise** from 2 % in 2000 to 16 % in 2080. This is related to 59 more very hot days per year over this period. As a consequence, **heat-related mortality** is estimated to **increase by a factor of five** by 2080.

Precipitation trends are highly uncertain and show strong regional differences. Projections for Mali indicate an **average decrease of 10 mm in annual precipitation by 2080**. Future dry and wet periods are likely to become **more extreme**.

Climate change is likely to cause **severe damage to the infrastructure** sector in Mali. Especially transport infrastructure is vulnerable to extreme weather events, yet essential for trading agricultural goods. Investments will need to be made into climate-resilient roads and other infrastructure.

The models project a possibility of an **increase in crop land exposure to drought**. Yields of heat- and drought-sensitive crops such as maize are projected to decline, while yields of rice are projected to benefit from CO_2 fertilisation. Farmers will need to adapt to these changing conditions.

Context

Mali is a **landlocked country in Western Africa**, belonging to the Sahel and Sahara region. The population is projected to **exceed 20 million in 2020** and **expected to double by 2035**, given the current annual demographic growth rate of 3 % [1], [2]. The majority of the inhabitants live in the southern part of the country, mainly due to a hotter and drier climate in the northern Sahel and Sahara region [2]. With a real GDP per capita of 794 USD, Mali is one of the poorest countries in the world, counting as a **least developed country (LDC)** [1]. Mali's economy is dominated by the agricultural sector, contributing 38.7 % to the country's GDP in 2018, followed by services with 36.9 % and industry with 19.1 % [3]. **Staple crop production is dominated by cereals such as millet, sorghum, maize, rice and cow peas** [4]. **Gold, cotton and livestock are Mali's key exports** with oilseeds, tropical fruits, nuts (coconuts, Brazil nuts, cashews), groundnuts and cassava being the most important cash crops [5]. **80 % of the population is engaged in smallholder farming and heavily relies on agriculture for food security and livelihoods** [6].

Therefore, concerns are rising about the effects of climate change including rising temperatures, reduced water availability and the occurrence of floods and other extreme weather events. **Agricultural production in Mali is primarily subsistence-based and rainfed**. Only 1 % of the total national crop land was equipped for irrigation in 2013 [6]. Especially smallholder farmers suffer from the impacts of climate variability, which can reduce their food supply and increase the risk of hunger and poverty. **Limited adaptive capacity in the agricultural sector underlines the country's vulnerability to climate change**. Many Malians from rural areas migrate to nearby villages and towns or to neighbouring countries to find seasonal work in agriculture and mining. Major destinations include **Côte d'Ivoire, which currently hosts approximately 359 000 migrants from Mali**, followed by Nigeria and Mauritania [7]. A smaller number of people leave the country to live permanently in Europe, joined by other migrants from the region, who increasingly use **Mali as a transit country** [8].

Quality of life indicators [1], [9]–[11]

Human Development Index (HDI) 2018	ND-GAIN Vulnerability Index 2017	GINI Coefficient 2009	Real GDP per capita 2019	Poverty headcount ratio 2009	Prevalence of under-nourishment 2016–2018
0.427 **184 out of 189** (0 = low, 1 = high)	**33.6** **166 out of 181** (0 = low, 100 = high)	**33.0** (0–100; 100 = perfect inequality)	**794 USD** (constant 2010 USD)	**49.7 %** (at 1.9 USD per day, 2011 PPP) [1]	**6.3 %** (of total population)

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[1] Poverty headcount ratio for the year 2009 adjusted to 2011 levels of Purchasing Power Parity (PPP). PPP is used to compare different currencies by taking into account national differences in cost of living and inflation.

Topography and environment

Located on plateaus and plains, Mali's landscape is mostly flat [12]. With the exception of the Senegal River, which is the lowest point of the country at 23 m, and Mount Hombori, the highest point at 1 153 m, **altitudes range between 200 and 500 m**. The north and centre of Mali are characterised by desert, which is why pastoralism is the main livelihood here. The south is dominated by steppe and a tropical savannah zone, where agricultural production is more diversified. Mali can be divided into **six major agro-ecological zones** (AEZ): Desert, Arid / Sahel, Semi-arid / Sudan Savannah, Northern Guinea Savannah, Southern Guinea Savannah and Derived Savannah (Figure 1) [adapted from 13].[1] Each of these zones is characterised by specific temperature and moisture regimes and, consequently, specific patterns of crop production and pastoral activities. Having its peak in August, the **rainy season occurs between May and October** with a shorter period in the north [14]. In terms of surface water, Mali's major sources are the rivers **Niger and Senegal**. The Niger flows through Mali for more than 1 600 km – first through Bamako and then north-east to Timbuktu before taking a south-east bend. The Niger is a **major source of water** in this arid part of the country and also acts as an **important transportation link** between different regions within Mali and to neighbouring countries as well. However, the development of hydropower dams in Guinea, such as the Fomi Dam, raises concerns about changes in the flow regime, which could lead to reductions of water resources further downstream and thus impact sensitive ecosystems and livelihoods [15]. Mali is facing major environmental issues including **land degradation, soil erosion** and, consequently, loss of pasture land [2]. Heavier precipitation and drier conditions are expected to intensify in the context of climate change, highlighting the **need for adaptation strategies in order to protect biodiversity and maintain fragile ecosystems and their services**.

Present climate [14]

The climate in Mali is generally hot and dry. The north is characterised by desert with annual mean temperatures of up to 30 °C and high rates of evapotranspiration. Precipitation is decreasing towards the north, with annual precipitation sums as low as 20 mm.

In the south of Mali, the climate is more tropical: Annual mean temperature is around 27 °C, reaching annual precipitation sums of up to 1 100 mm, which makes this region more suitable for crop production.

Mali has a single rainy season (unimodal precipitation regime), receiving most of its annual precipitation between May and October.

Figure 1: Topographical map of Mali with agro-ecological zones and existing precipitation regimes.[3]

[2] It should be noted that there are different classifications of AEZs in Mali. We focused on a commonly used classification of six AEZs.
[3] The climate diagrams display temperature and precipitation values which are averaged over an area of approximately 50 km × 50 km. Especially in areas with larger differences in elevation, the climate within this grid might vary.

Projected climate changes

How to read the line plots

historical | best estimate
RCP2.6 | likely range
RCP6.0 | very likely range

Lines and shaded areas show multi-model percentiles of 31-year running mean values under RCP2.6 (blue) and RCP6.0 (red). In particular, lines represent the best estimate (multi-model median) and shaded areas the likely range (central 66 %) and the very likely range (central 90 %) of all model projections.

How to read the map plots

Colours show multi-model medians of 31-year mean values under RCP2.6 (top row) and RCP6.0 (bottom row) for different 31-year periods (central year indicated above each column). Colours in the leftmost column show these values for a baseline period (colour bar on the left). Colours in the other columns show differences relative to this baseline period (colour bar on the right). The presence (absence) of a dot in the other columns indicates that at least (less than) 75 % of all models agree on the sign of the difference.
For further guidance and background information about the figures and analyses presented in this profile kindly refer to the supplemental information on how to read the climate risk profile.

Temperature

In response to increasing greenhouse gas (GHG) concentrations, **air temperature over Mali is projected to rise by 2.0 to 4.6 °C (very likely range) by 2080** relative to the year 1876, depending on the future GHG emissions scenario (Figure 2). Compared to pre-industrial levels, median climate model temperature increases over Mali amount to approximately 2.2 °C in 2030, 2.6 °C in 2050 and 2.7 °C in 2080 under the low emissions scenario RCP2.6. Under the medium/high emissions scenario RCP6.0, median climate model temperature increases amount to 2.2 °C in 2030, 2.8 °C in 2050 and 4.0 °C in 2080.

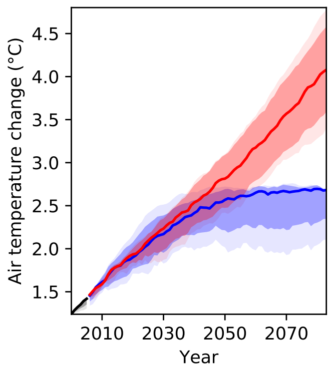


Figure 2: Air temperature projections for Mali for different GHG emissions scenarios.[4]

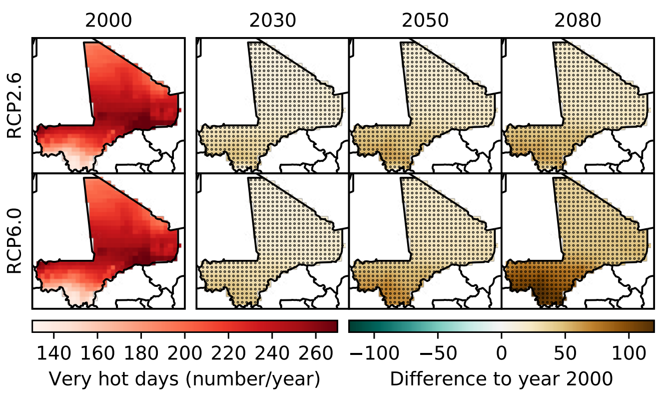


Figure 3: Projections of the annual number of very hot days (daily maximum temperature above 35 °C) for Mali for different GHG emissions scenarios.

Very hot days

In line with rising mean annual temperatures, the annual number of very hot days (days with daily **maximum temperature above 35 °C**) is projected to rise dramatically and with high certainty all over Mali (Figure 3). Under the medium/high emissions scenario RCP6.0, the multi-model median, averaged over the whole country, projects **23 more very hot days per year in 2030 than in 2000, 34 more in 2050 and 59 more in 2080**. In some parts, especially in central Mali, this amounts to about 300 days per year by 2080.

[4] Changes are expressed relative to year 1876 temperature levels using the multi-model median temperature change from 1876 to 2000 as a proxy for the observed historical warming over that time period.

Precipitation

Models project no clear trend for precipitation, which is due to high uncertainty and natural year-to-year variability (Figure 4). Out of the four climate models underlying this analysis, one model projects an increase in mean annual precipitation over Mali, one model projects no change, while two models project a decrease under RCP6.0. Median model projections for RCP2.6 show **a slight decrease of 2 mm in precipitation until 2080**, while median model projections for RCP6.0 show **a stronger precipitation decrease of 10 mm by 2080** compared to year 2000.

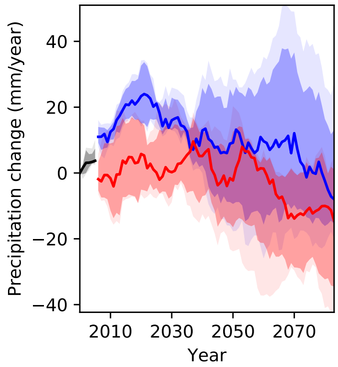


Figure 4: Annual mean precipitation projections for Mali for different GHG emissions scenarios, relative to the year 2000.

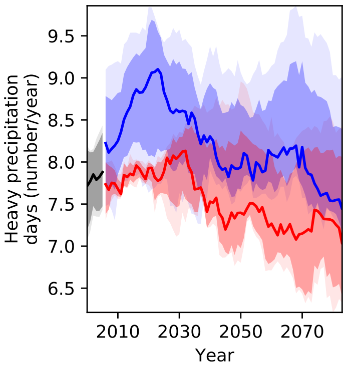


Figure 5: Projections of the number of days with heavy precipitation over Mali for different GHG emissions scenarios, relative to the year 2000.

Heavy precipitation events

In response to global warming, **heavy precipitation events are expected to become more intense** in many parts of the world due to the increased water vapour holding capacity of a warmer atmosphere. At the same time, the number of days with heavy precipitation events is expected to increase. However, this tendency cannot be found in climate projections for Mali: Two models project a decrease, one projects no change and only one model projects an increase. Median climate model projections show **a slight decrease in the number of days with heavy precipitation** from 7.7 in the year 2000 to 7.5 (RCP2.6) and 7.3 (RCP6.0) by 2080 (Figure 5).

Soil moisture

Soil moisture is an important indicator for drought conditions. In addition to soil parameters and management, it depends on both precipitation and evapotranspiration and therefore also on temperature, as higher temperatures translate to higher potential evapotranspiration. **Annual mean top 1-m soil moisture projections for Mali show no change under RCP2.6 and a decrease of 3.7 % under RCP6.0 by 2080** compared to the year 2000 (Figure 6). However, there is considerable spatial variability and modelling uncertainty, as different hydrological models project different directions of change, which makes it difficult to identify a clear trend.

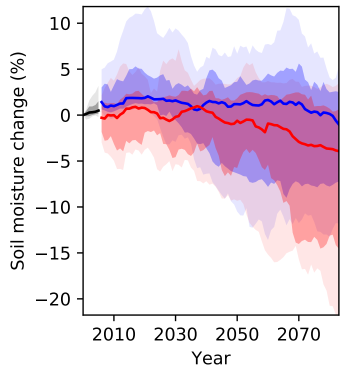


Figure 6: Soil moisture projections for Mali for different GHG emissions scenarios, relative to the year 2000.

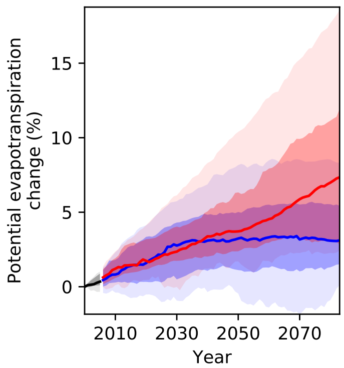


Figure 7: Potential evapotranspiration projections for Mali for different GHG emissions scenarios, relative to the year 2000.

Potential evapotranspiration

Potential evapotranspiration is the amount of water that would be evaporated and transpired if sufficient water was available at and below the land surface. Since warmer air can hold more water vapour, **it is expected that global warming will increase potential evapotranspiration in most regions of the world.** In line with this expectation, hydrological projections for Mali indicate a stronger rise of potential evapotranspiration under RCP6.0 than under RCP2.6 (Figure 7). Under RCP6.0, **potential evapotranspiration is projected to increase by 2.4 % in 2030, 3.7 % in 2050 and 7.0 % in 2080** compared to year 2000 levels.

Sector-specific climate change risk assessment

a. Water resources

Current projections of water availability in Mali display high uncertainty under both GHG emissions scenarios. Assuming a constant population level, multi-model median projections suggest only slight decreases in water availability over Mali by the end of the century under both emissions scenarios (Figure 8A). Yet, when accounting for population growth according to SSP2 projections[5], **per capita water availability for Mali is projected to decline by 77 % by 2080** relative to the year 2000 under both scenarios (Figure 8B). While this decline is primarily driven by population growth, rather than climate change, it highlights the great urgency to invest in water saving measures and technologies for future water consumption.

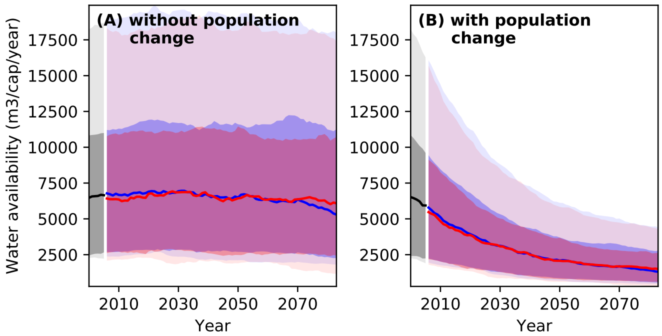


Figure 8: Projections of water availability from precipitation per capita and year with (A) national population held constant at year 2000 level and (B) changing population in line with SSP2 projections for different GHG emissions scenarios, relative to the year 2000.

Projections of future water availability from precipitation vary depending on the region and scenario (Figure 9). In line with precipitation projections, **water availability is projected to decline by 20 % in the south-west of Mali by 2080** under both RCPs. In the northern half of the country, however, water availability is projected to increase by 15 % under RCP2.6. Under RCP6.0, model agreement on these increases is low towards the end of the century. This modelling uncertainty, along with the high natural variability of precipitation, contributes to **uncertain future water availability** in particular in the north of Mali.

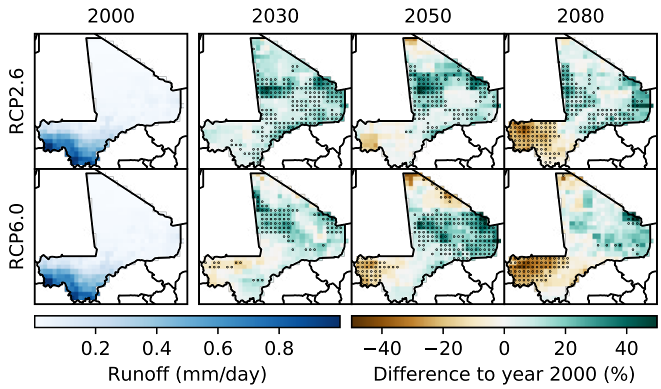


Figure 9: Water availability from precipitation (runoff) projections for Mali for different GHG emissions scenarios.

Over the last decades, Mali has experienced strong seasonal and annual variations in precipitation, which present a major constraint to agricultural production [16], [17]. Mali was hit by **severe droughts between 1970 and 2000** as a result of declining levels of precipitation since the mid-1950s. Although precipitation levels recovered towards the year 2000, they have remained below the national average of the past century [18]. The 2012 Sahel drought **affected a total of 4.6 million people** in Mali [19]. Extreme droughts tend to have a cascading effect: First, lack of water reduces crop yields, which increases the risk of food insecurity for people and their livestock, which in turn limits their capacity to cope with future droughts. Transhumance used to be an effective way to deal with variations in precipitation and droughts in Mali. However, people's reliance on this type of pastoralism has been challenged by increasingly unpredictable precipitation patterns.

The resulting **lack of pastures and water** has led to **increasing competition over these scarce resources**, particularly along the Niger River and in the Inner Niger Delta. Other factors complicating transhumance include poor natural resource management, population growth, conflicts between farmers and herders and terrorist activities in the greater region, making this mode of living less profitable and sometimes even dangerous [20].

[5] Shared Socio-economic Pathways (SSPs) outline a narrative of potential global futures, including estimations of broad characteristics such as country-level population, GDP or rate of urbanisation. Five different SSPs outline future realities according to a combination of high and low future socio-economic challenges for mitigation and adaptation. SSP2 represents the "middle of the road"-pathway.

b. Agriculture

Smallholder farmers in Mali are increasingly challenged by the uncertainty and variability of weather that climate change causes [16], [17]. Since **crops are predominantly rainfed**, crop yields depend on water availability from precipitation and are prone to drought. However, the length and intensity of the rainy season is becoming increasingly unpredictable and the **use of irrigation facilities remains limited** despite Mali's considerable irrigation potential of approximately 566 000 ha (1.4 % of the national crop land) [21], [22]. Currently, **only 30 % of that potential is irrigated** [6]. Especially in central and northern Mali, soils are sandy and poor in nutrients, which complicates irrigation and crop production.

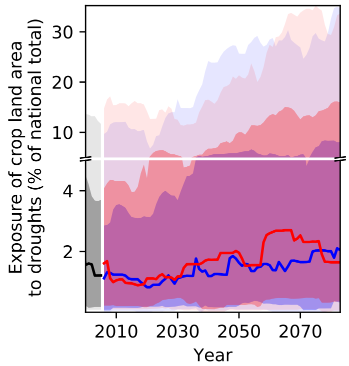
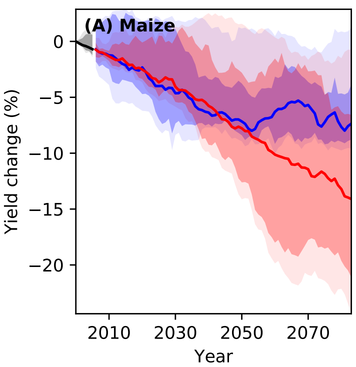


Figure 10: Projections of crop land area exposed to drought at least once a year for Mali for different GHG emissions scenarios.

Currently, the high uncertainty of projections regarding water availability (Figure 9) translates into high uncertainty of drought projections (Figure 10). According to the median over all models employed for this analysis, **the national crop land area exposed to at least one drought per year will hardly change in response to global warming.** However, there are **models that project a strong increase in drought exposure.** Under RCP6.0, the likely range of drought exposure of the national crop land area per year widens from 0.2–4.5 % in 2000 to 0.03–15.0 % in 2080. The very likely range widens from 0.1–13.6 % in 2000 to 0.02–29.4 % in 2080. This means that **some models project up to a threefold increase in drought exposure over this time period, while others project no change.**

In terms of yield projections, model results indicate a **negative trend for maize, millet, sorghum and groundnuts** (Figure 11). While maize is sensitive to hot temperatures above 35 °C, millet, sorghum and groundnuts tolerate hot temperatures and dry periods better [23]. Compared to the year 2000, yields are projected to decline by 13 % for maize, 12 % for millet and sorghum, and 7 % for groundnuts by 2080 under RCP6.0. Under RCP2.6, yields are projected to decline by 8 % for maize, 8 % for millet and sorghum, and 14 % for groundnuts. **Yields of rice, on the contrary, are projected to gain from climate change**. Under RCP6.0, yields are projected to increase by 29 % by 2080 relative to the year 2000. A possible explanation for the positive results under RCP6.0 is that rice is a so-called C3 plant, which follows a different metabolic pathway than maize, millet and sorghum (C4 plants), and benefits more from the CO_2 fertilisation effect under higher concentration pathways. **Yields of cow peas are projected to decrease under RCP2.6 and remain unchanged under RCP6.0**. The decrease under RCP2.6 can be explained by non-temperature related parameters such as changes in precipitation, while the trend under RCP6.0 can be explained by the CO_2 fertilisation effect. This explanation also applies to the projected stronger decrease in yields of groundnuts under RCP2.6.

Overall, adaptation strategies such as switching to improved varieties in climate change sensitive crops need to be considered, yet should be carefully weighed against adverse outcomes, such as a resulting decline of agro-biodiversity and loss of local crop types.



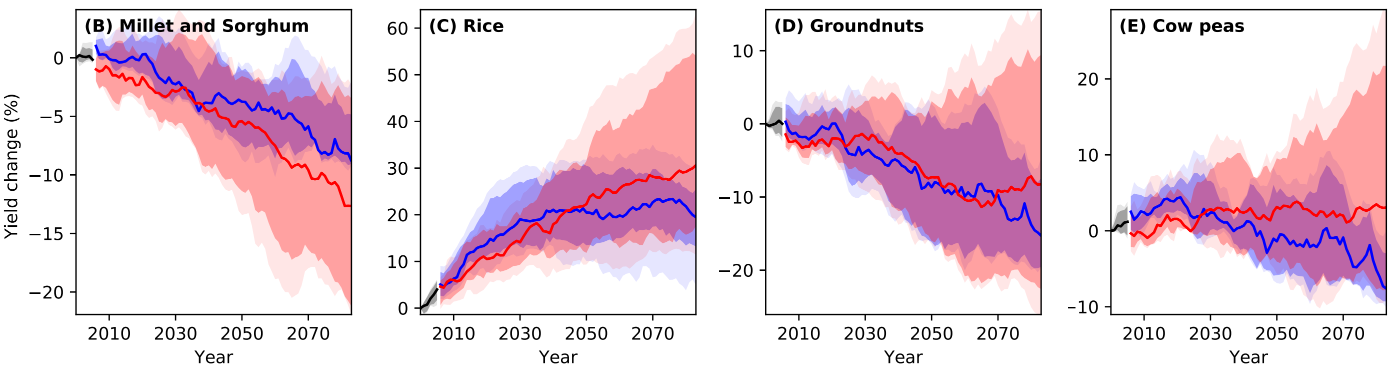


Figure 11: Projections of crop yield changes for major staple crops in Mali for different GHG emissions scenarios assuming constant land use and agricultural management.

c. Infrastructure

Climate change is expected to significantly affect Mali's infrastructure sector through extreme weather events, such as flooding and droughts (Figure 12). High precipitation amounts can lead to **flooding of roads,** while high temperatures can cause **roads, bridges and protective structures to develop cracks and degrade more quickly**. Transport infrastructure is very vulnerable to extreme weather events, yet essential for social, economic and agricultural livelihoods. Roads serve communities to trade their goods and access healthcare, education, credit as well as other services, especially in rural and remote areas. The **absence of railways, seasonal navigability of the Niger River and limited airport facilities** increase Mali's reliance on road transportation. Yet, Mali has **one of the lowest road densities in Africa** with an average of 38 km / 1 000 km² [24]. Furthermore, only 17 % of Mali's rural population lives within 2 km of an all-season road, which is 60 % below the African average [24]. Therefore, **investments will have to be made into building climate-resilient road networks**.

Extreme weather events will also have **devastating effects on human settlements and economic production sites**, especially in urban areas with high population densities like Bamako or Sikasso. **Informal settlements are particularly vulnerable to extreme weather events**: Makeshift homes are often built in unstable geographical locations including river banks, where flooding can lead to loss of housing, contamination of water, injury or death. Dwellers usually have low adaptive capacity to respond to such events due to high levels of poverty and a lack of risk-reducing infrastructures. For example, **heavy rains in July and August 2018 caused flooding** in different regions across Mali, particularly affecting communities along the Niger River including Bamako, Gao, Koulikoro, Mopti, Segou and Timbuktu [25]. A total of **137 000 people were affected** (the highest number compared to the previous 6 years), **6 350 houses were destroyed** and **2 680 head of cattle were killed** [25]. Flooding and droughts will also affect hydropower generation: Mali draws 60 % of its energy from hydropower, with a total installed capacity of 528 MW in 2014 [26]. However, variability in precipitation and **climatic conditions could severely disrupt hydropower generation**.

Despite the risk of infrastructure damage being likely to increase due to climate change, precise predictions of the location and the extent of exposure are difficult to make. For example, projections of river flood events are subject to substantial modelling uncertainty, largely due to the uncertainty of future projections of precipitation amounts and their spatial distribution, affecting flood occurrence (see also Figure 4). In the case of Mali, projections for both RCP2.6 and RCP6.0 show **almost no change in the exposure of major roads to river floods**. In 2000, 1.7 % of major roads were exposed to river floods at least once a year, while by 2080, this value is projected to change to 1.9 % under RCP2.6 and to 2.0 % under RCP6.0. Similarly, **exposure of urban land area to river floods is projected to hardly change under either RCP** (Figure 13).

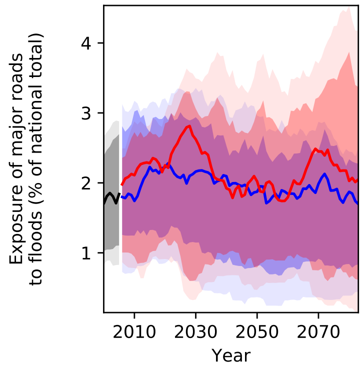


Figure 12: Projections of major roads exposed to river floods at least once a year for Mali for different GHG emissions scenarios.

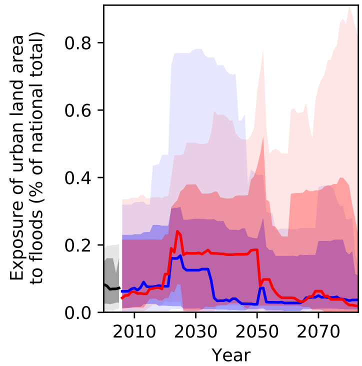


Figure 13: Projections of urban land area exposed to river floods at least once a year for Mali for different GHG emissions scenarios.

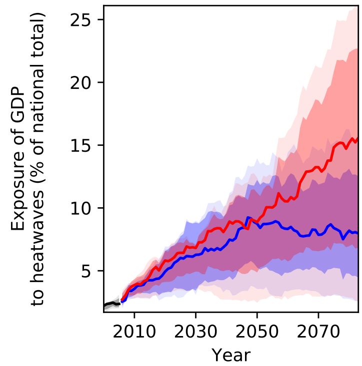


Figure 14: Exposure of GDP in Mali to heatwaves for different GHG emissions scenarios.

While three of four models project **an increase in the exposure of the GDP to heatwaves**, the magnitude of the increase is subject to high modelling uncertainty with one model projecting very strong and two models projecting weaker increases (Figure 14). Median model projections for RCP2.6 show an increase from 2.2 % in 2000 to 8.7 % by 2080, whereas under RCP6.0, exposure is projected to increase to 15.2 %. It is recommended that policy planners start identifying heat-sensitive economic production sites and activities, and integrating climate adaptation strategies, such as improved, solar-powered cooling systems, "cool roof" isolation materials or switching the operating hours from day to night [27].

d. Ecosystems

Climate change is expected to have a significant influence on the ecology and distribution of tropical ecosystems, though the magnitude, rate and direction of these changes are uncertain [28]. With rising temperatures and increased frequency and intensity of droughts, **wetlands and riverine systems are increasingly at risk of being converted to other ecosystems,** with plants being succeeded and animals losing habitats. Increased temperatures and droughts can also impact succession in forest systems while concurrently increasing the risk of invasive species, all of which affect ecosystems.

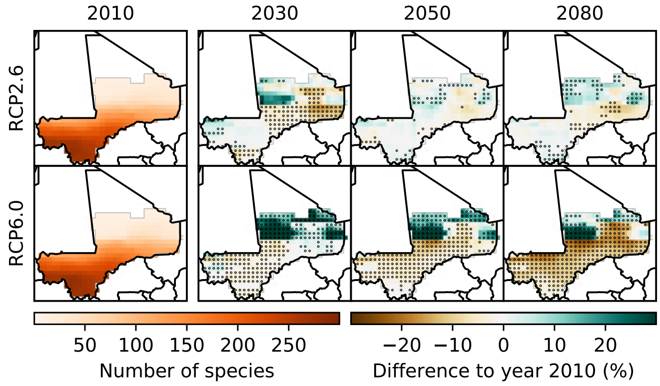


Figure 15: Projections of the aggregate number of amphibian, bird and mammal species for Mali for different GHG emissions scenarios.

Model projections of species richness (including amphibians, birds and mammals) and tree cover for Mali are shown in Figure 15 and 16, respectively. Under RCP6.0, **species richness is projected to decrease** by 10 % **in the southern half of Mali** by 2080 compared to the year 2000. In the centre, however, species richness is projected to increase by up to 30 % (Figure 15). All models agree on this trend. In terms of tree cover, model agreement is lower: Models project **increases in tree cover of up to 1.5 % in parts of southern Mali** under RCP6.0 (Figure 16). Projections of both species richness and tree cover under RCP2.6 are subject to high modelling uncertainty.

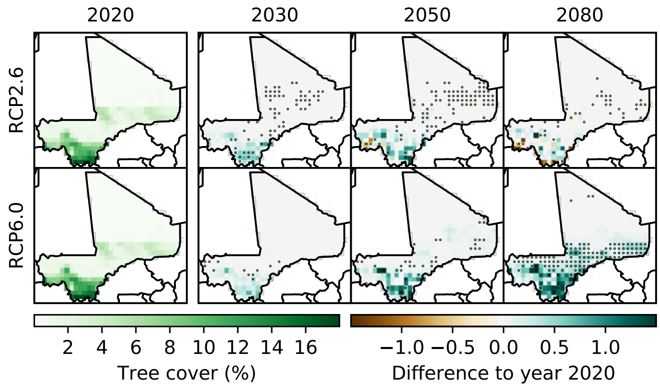


Figure 16: Tree cover projections for Mali for different GHG emissions scenarios.

Although these results suggest a positive picture for climate change impacts on tree cover, it is important to keep in mind that the **model projections exclude any impacts on biodiversity loss from human activities such as land use**, which have been responsible for significant losses of global biodiversity in the past, and are expected to remain its main driver in the future [29]. For example, rapid growth of agricultural production and logging have resulted in **high rates of deforestation:** Mali has lost 330 000 ha of forest cover in the period from 2001 to 2018, which is equivalent to a 13 % decrease since 2000 [30]. Given Mali's **rapid population growth**, this trend is likely to continue and will impact animal and plant biodiversity.

e. Human health

Climate change threatens the health and sanitation sector through more frequent incidences of heatwaves, floods, droughts and storms. Among the key health challenges in Mali are morbidity and mortality through vector-borne diseases, such as malaria, waterborne diseases related to extreme weather events (e.g. flooding), such as diarrhoea, respiratory diseases, malnutrition, HIV/AIDS, meningitis, injury and mortality through extreme weather events [31]. Climate change can **impact food and water supply, which can increase the risk of malnutrition, hunger and death by famine**. Scientific investigations found a link between extreme weather events and mortality patterns in Mali: Precipitation events of more than 10 mm per day were negatively associated with survival of children under five years of age, while colder temperatures were associated with lower mortality rates among the general population [32], [33].

Furthermore, **climate change is likely to lengthen transmission periods and alter the geographic range of diseases**, such as malaria or meningitis. Malaria continues to be the primary cause of morbidity and mortality in Mali, particularly among children under the age of 5 [34]. In some regions, malaria risk will likely increase, for instance, due to higher occurrence of flooding, but overall risk is projected to fall due to rising temperatures [35], [36]. Temperature increases could also lead to more frequent outbreaks of meningitis [37]. Mali is part of the so-called Meningitis Belt, which largely coincides with the Sahel region and which is where the majority of meningitis epidemics occur. **Access to health care in Mali remains limited** and is being further **complicated by armed conflict**: According to Médecins Sans Frontières (MSF), many public and humanitarian health organisations have limited or even closed down their operations due to armed conflicts [38].

Rising temperatures will result in **more frequent heatwaves** in Mali, leading to **increased heat-related mortality.** Under RCP6.0, the population affected by at least one heatwave per year is projected to increase from 2 % in 2000 to 16 % in 2080

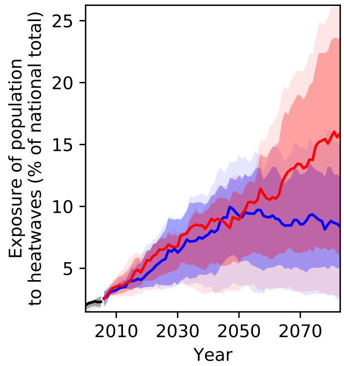


Figure 17: Projections of population exposure to heatwaves at least once a year for Mali for different GHG emissions scenarios.

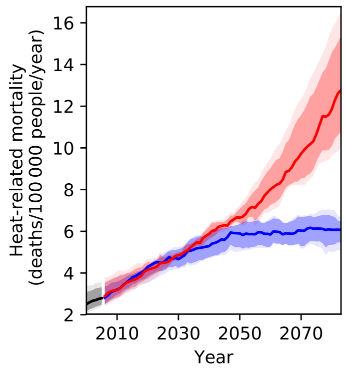


Figure 18: Projections of heat-related mortality for Mali for different GHG emissions scenarios assuming no adaptation to increased heat.

(Figure 17). Furthermore, under RCP6.0, **heat-related mortality will likely increase from 2.5 to about 12 deaths per 100 000 people per year**, which equals a factor of more than five towards the end of the century compared to year 2000 levels, provided that no adaptation to hotter conditions will take place (Figure 18). Under RCP2.6, heat-related mortality is projected to increase to about 6 deaths per 100 000 people per year in 2080.

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