CÔTE D'IVOIRE

AFRICAN DEVELOPMENT BANK

NATIONAL CLIMATE CHANGE PROFILE

PRODUCED IN COLLABORATION WITH:
African Climate & Development Initiative, University of Cape Town;
Climate Systems Analysis Group, University of Cape Town;
Energy Research Centre, University of Cape Town; Cirrus Group.

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ACKNOWLEDGEMENT

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1. BACKGROUND

1.1 Geographic and socio-economic context

The Republic of Côte d'Ivoire (also known as Ivory Coast, and henceforth 'Côte d'Ivoire') is a West African country situated at the Gulf of Guinea peninsula of the Atlantic Ocean. Côte d'Ivoire is an important regional economic hub and trade port, and is bordered by Ghana to the east, Burkina Faso and Mali to the north, and by Liberia and Guinea to the west. The economy of Côte d'Ivoire is historically based on agriculture, with approximately half of the country's workforce in agriculture, and exports of coffee and cocoa providing the foundation for a period of growth and development in the post-independence period. Although up to 50% of the population live in urban areas (increasing at a rate of ~3.8% annually), the majority of the rural population are reliant on various forms of cash crop and subsistence agriculture. Despite the large contributions of the agriculture sector to Côte d'Ivoire's development, the exposure of agricultural exports to fluctuations in price, demand and exchange rates has resulted in several periods of economic downturn and increased external debt. At present, the country's economic base is increasingly diversified to include telecommunications, finance, transport, energy, and trade and is considered to be one of the fastest-growing economies in Africa. However, socio-economic disparities remain relatively widespread, with an estimated ~29% of the population living below the poverty line, ~38.1% of the population without electricity access, and a gender inequality index score of ~68 (the 3rd highest in Africa). Further, with respect to socio-economic disparities, Côte d'Ivoire's GINI co-efficient is estimated to be ~43. Côte d'Ivoire's ND-GAIN index is 41.5 and is composed of a low readiness and high vulnerability score. This index summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience and the score indicates that the country has both a great need for investment and innovations to improve readiness and a great urgency for action. Key socio-economic and demographic indicators are further presented and summarised in Table 1-1, below.

Figure 1-1: Map of Côte d'Ivoire

Table 1-1: Socio-Economic Context of Côte d'Ivoire (reference year ranges from 2014 - 2017)

VARIABLE		SCORE/TOTAL	UNIT	RANK (OUT OF 54)
Geography, socio-economy and demographics				
Population[1]		23,815,886	people	17
Population growth rate[1]		2.4	% population .yr^{-1}	29
Population density[1]		75	People/km^2	22
Land area[1]		317,969	km^2	28
% Urban population[1]		50.2	% population	18
% Urbanisation rate[2]		3.8	% population .yr^{-1}	24
Economy: total GDP[2]		36.2	USD billions .yr^{-1}	13
Economy: GDP by PPP[2]		88	billion international dollars.yr^{-1}	13
Economy: GDP/capita[2]		1,526	USD per capita /yr	19
Population below the poverty line[3]		29.0	% below USD 1.90 per day	32
Gender Inequality Index[4]		67.9		3
GINI co-efficient[3]		43.2		24
HDI[5]		0.47		36
Access to electricity[6]		61.9	% population	16
Summary indicators of climate change vulnerability				
Workforce in agriculture[7]		48.3	% workforce	20
Population undernourished[8]		13.3	% population	24
Number of people affected by flood events[9]		8,875	people	45
Population living within 100 km of coast[10]		8,388,398	people	12
Population living in informal settlements [5]		56.0	% urban population	24
Incidence of malaria[8]		349	cases per 1000 population at risk	6
ND-Gain Vulnerability Index[11]	Total	41.5		18
	Readiness	0.33		26
	Vulnerability	0.50		38

2. CLIMATE AND WEATHER

Côte d'Ivoire's climate is generally warm and humid with temperature averaging around 27°C over most parts and up to 29° C in the north. The southern parts experience two rainy seasons which shifts into a single summer rainy season towards the central and northern parts.

The water region of Côte d'Ivoire extends to the north of country's border into Burkina Faso. Climate variation, especially in the seasonality of rainfall, within that region are relatively large therefore three sub-regions are distinguished here. The Côte d'Ivoire region is illustrated in **Figures 2-1** and **2-2**, below, and summary descriptions can be found in **Table 2-1** below.

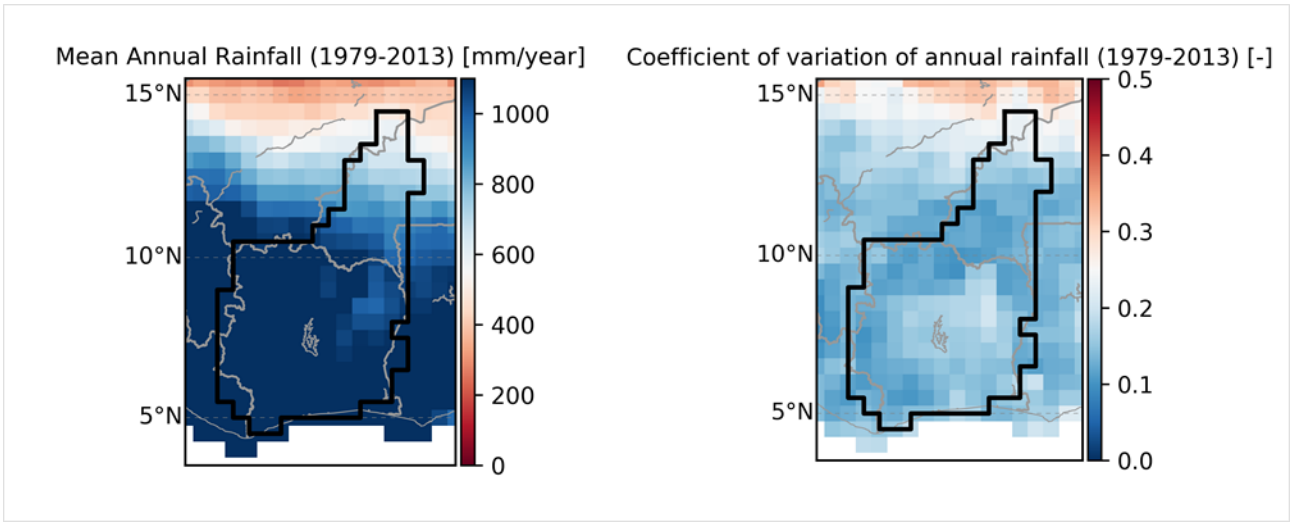
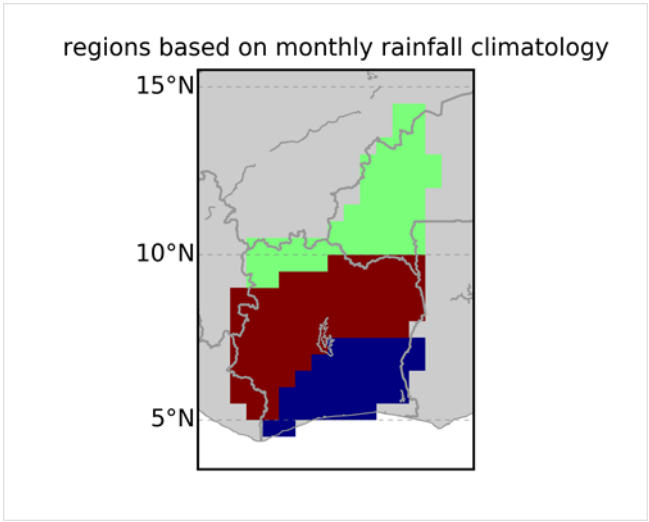


Figure 2-1: Main characteristics (magnitude and variability) of rainfall in Côte d'Ivoire and its region



Coloured regions on the map (above) correspond to the colours used in rainfall and temperature graphs (below)

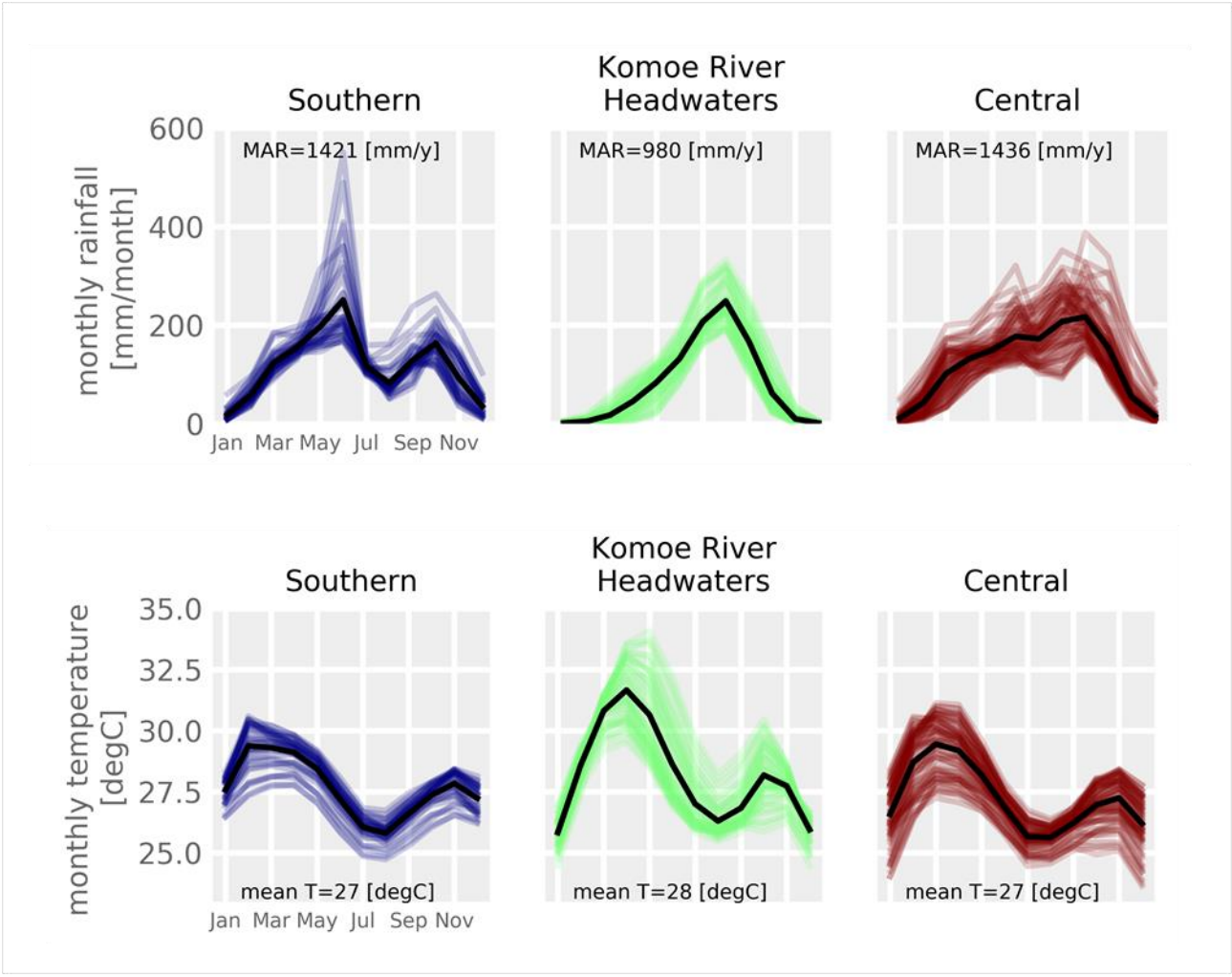


Figure 2-2: Rainfall regions of Côte d'Ivoire based on similarity of standardised rainfall climatology, and their rainfall and temperature climatologies

Table 2-1: Main characteristics of rainfall of Côte d'Ivoire region

KOMOE RIVER HEADWATERS	A hot region with a daily mean temperature of 28° C and a mean annual total rainfall of 980 mm/year. Spatially rainfall decreases, and interannual variability increases, from south to north over the region. Rainfall occurs in a single rainy season from April to September, peaking at just over 200 mm/month during August. A dry season occurs from November to March. Temperature shows a seasonal variation of around 6° C and exhibit a slight bimodal seasonal pattern. Temperatures are highest at the beginning of the rainy season where they average around 32° C from March-May. A secondary maximum occurs towards the end of the rainy season in October. Temperatures are coolest during boreal winter (December – January) where they average about 25.5° C.
CENTRAL	A warm and humid climate with a daily mean temperature of 27° C and mean annual total rainfall of 1440 mm/year with relatively low to moderate interannual variability, but quite high spatial variability with rainfall decreasing towards the north-east. Rainfall occurs in one very long rainy season from March to October, peaking at just over 200 mm/month during September. A relatively dry season occurs during boreal winter from November to February. Temperature show a seasonal difference of about 4° C and exhibits a bimodal pattern, with highest temperatures at the start of the rainy season (March - May), with a secondary peak towards the end of the rainy season (October – November) and coolest temperatures during December - January and July – September.
SOUTHERN	A warm and humid climate with a daily mean temperature of 27° C and mean annual total rainfall of 1420 mm/year with relatively low interannual variability, but quite high spatial variability especially during the peak of the rainy season. Rainfall shows a bimodal seasonal climatology. The long rains occur from April to June, peaking at around 230 m/month in June. The short rains occur from September to October peaking at around 180 mm/month in October. Rainfall occurs between the two rainy seasons but is very low during December to January. Temperature show small seasonal differences (<5° C) but does exhibits a bimodal pattern, with highest temperatures at the start of the long rains (February – April), with a secondary peak over the latter half of the short rains (October – November) and coolest temperatures during December - January and July – September.

2.1 Observed historical climate variations and climate trends

The majority of Côte d'Ivoire experiences **relatively low rainfall variability** on an inter-annual basis, with the exception of the far north. Côte d'Ivoire also experiences **some variability** with some periods being relatively drier or wetter than others. This variability can be seen in the supporting evidence plots provided in the supplementary Appendix **(Figures A-1 to A-4).**

Long term trends across the regions show only slight **increasing temperatures** over the period 1979 – 2015, and the trend is only statistically significant over the Komoe River Headwaters Region. Long term trends in total annual rainfall are small. The Komoe River Headwaters region shows a slight upward trend, the Southern Region shows a slight downward trend and the Central Region shows no discernible trend over the last 35 years. All regions do show a statistically significant decrease in the frequency of rainfall, but an increase in the frequency of extreme rainfall events. Long term trends and variability in the Côte d'Ivoire regions are summarized in **Table 2-2** below and illustrated further in the supplementary Appendix **(Figures A-1 to A-4).**

Table 2-2: Summary of trends in rainfall and temperature attributes in Côte d'Ivoire (1979 - 2015)

REGION	MEAN T [DEG C/DECADE]	TOTAL RAINFALL [MM/DECADE]	EXTREME RAINY DAYS [DAYS/DECADE]	RAINY DAYS [DAYS/DECADE]
Komoe River Headwaters	+0.12	slight upward	+3.4	-6.0
Central	slight upward	not evident	+2.4	-4.7
Southern	0.06	slight downward	slight upward	-6.0

2.2 Projected (future) climate change trends, including temperature, precipitation and seasonality

Projected changes in main attributes of climate for the Côte d'Ivoire region are summarized in Table 2-3, below, and described in Sections 2.2.1 and 2.2.1. Additional analysis and visualisation of projections be found in **Figures A-5 to A-8** in the supplementary Appendix.

2.2.1 Projected changes in precipitation from present to 2100

Rainfall projections across the Côte d'Ivoire regions show no consistent signal in the projections of annual total rainfall. The Southern and Central Regions project that the frequency of rainfall will remain within the normal range or may decrease, but that the frequency of extreme rain events may remain constant or increase into the future. The Komoe River Headwaters Region shows no consistent signal in rainfall frequency but does project that extreme rainfall may remain normal or may increase into the future. It must be noted that these results are derived from GCM projections which may not accurately represent changes in extreme rainfall dynamics. They are, however, consistent with the increased convective rainfall intensity (e.g. thunderstorm-related rainfall) expected in a warmer climate.

2.2.2 Projected changes in temperature from present to 2100

Air temperature is projected to be about 1.5 - 3°C warmer in the Côte d'Ivoire regions by the 2050s, with slightly less warming in the Southern Region. By 2100 the range of projected temperatures are greater with all regions showing projected increases of 3°C to 7°C.

Table 2-3: Summary of projected climate changes across regions of Côte d'Ivoire for key climate variables by 2050

REGION	AVERAGE TEMPERATURE [°C]	TOTAL ANNUAL RAINFALL [MM/YEAR]	EXTREME RAINY DAYS [DAYS/YEAR]	RAINY DAYS [DAYS/YEAR]
Komoe River Headwaters	**Increasing** +1.5°C to +3°C by 2050s but changes evident in next decades	No consistent signal in projections	**Normal to increasing,** ranging from slight decrease, to extreme increase by 2100.	No consistent signal in projections
Central	**Increasing** +1.5°C to +3°C by 2050s but changes evident in next decades	No consistent signal in projections	**Normal to increasing,** ranging from slight decrease, to extreme increase by 2100.	**Normal to decrease,** half the models show no change, other half show strong decrease of up to 10% by 2100.
Southern	**Increasing** +1°C to +2.5°C by 2050s but changes evident in next decades	No consistent signal in projections	**Normal to increasing,** ranging from slight decrease, to extreme increase by 2100.	**Normal to decrease,** half the models show no change, other half show strong decrease of up to 10% by 2100.

2.3 Expected climate vulnerabilities

NOTE: Determining vulnerability of different sectors to climate variations or change is extremely challenging as there are many factors involved in vulnerability and different approaches can yield different results. The vulnerabilities presented here are based on UNFCCC reporting documents such as national communications or national adaptation plans of action where available, and other literature where UNFCCC documents are not available.

In warm and humid Côte d'Ivoire, possible increase in extreme rainfall events, coupled with increasing temperatures, may stand to complicate access to safe drinking water as well as impact the climate sensitive agricultural sector. The economy of Côte d'Ivoire is historically based on agriculture, with exports of coffee and cocoa providing the foundation for a period of growth and development in the post-independence period. With the 50% of the population residing in rural areas relying on various forms of cash crop and subsistence agriculture, and with agricultural exports playing into the overall economy, this has possible implications for households, food security and the economy. While one of the fastest growing, and increasingly diversified, economies in Africa, socio-economic disparities and a third of the population living below the poverty line means that people's capacity to adapt to increasing temperatures and more extreme rainfall varies widely. Of the half of the population living in urban areas just over half reside in slums, with lack of proper access to critical services such as health care, water supply and proper housing, deeming them vulnerable to extreme temperatures and rainfall events, as well as the slower knock-on effects that climate change may have on the economy and agricultural production. Coastal human settlements and associated developments and activities are further vulnerable to sea-level rise and associated stresses.

Table 2-4: Broad scale sectoral vulnerabilities and potential climate change impacts in Côte d'Ivoire

SECTOR	POTENTIAL IMPACTS OF CLIMATE CHANGE
Agriculture	Changes in agricultural production, including livestock breeding and aquaculture Changes in coffee and cocoa production Changes to the climatically appropriate areas for agricultural production, with the cacao belt in the N'ZI Comoé region moving towards the centre-west, causing deforestation and migration Shortened growing season Increased exposure of plants to water stress Reduced biomass growth Degradation and loss of agricultural land Reduced productivity potential of ecosystems Reduced biodiversity in ecologically rich areas in the North-eastern, central and south-western parts of the country, owing to decreasing rainfall and rising temperatures
Fisheries	Changes in fishing activities required Coastal erosion
Water resources	Reduced run-off and surface water availability Changes in the availability of water resources Changes in Ivory Coast's extended hydrographic network and four large rivers, including Bandama River
Built infrastructure and human settlements	Damage to or destruction of coastal infrastructure, including transport networks Increased coastal erosion
Human health	Increased prevalence of vector-borne diseases such as malaria

3. CLIMATE CHANGE MITIGATION, GREENHOUSE GAS EMISSIONS AND ENERGY USE

The major carriers of Côte d'Ivoire's energy mix, and the energy demands of major economic sectors, are summarised in Section 3.1, below. The major sources of GHG emissions, described by fuel source and sector, are described in Section 3.2. The latter section also includes summarised statistics on Côte d'Ivoire's agriculture sector, historical land use change and vegetation cover.

3.1 National energy production and consumption

The energy sector of Côte d'Ivoire is characterised by a split between the commercial fossil fuel industry and the domestic use of biofuels. Côte d'Ivoire has reserves of natural gas and oil (the majority of which are offshore) which are consumed nationally as well as refined for export. Electricity, which is supplied to the local grid as well as exported to neighbouring countries (currently including Ghana, Mali and Burkina Faso), is generated by gas (~70%), oil (6%) and hydropower (23%). However, biofuel remains the largest contributor to total national energy production, accounting for 10.1 MTOE or ~78.4% of the total of 12.9 MTOE (Table 3-1).

With respect to national energy consumption of 7.7 MTOE, biofuels contribute 5.3 MTOE, electricity contributes 0.5 MTOE and direct consumption of gas contributes 0.3 MTOE (used for domestic as well as industrial applications). National consumption of oil is estimated to be ~1.7 MTOE, including domestic as well as imported resources (Table 3-2). Despite the large contribution of oil and gas exports to GDP, oil products contribute only ~26% to total national energy consumption while the remaining majority of national energy consumption is provided by biofuels in the domestic sector (residential sector consumes ~5.1 MTOE out of a national consumption total of 7.7 MTOE). Commercial and industrial sectors, transport and public services are the next-largest consumers of energy, accounting for ~2.5 MTOE (of which ~1 MTOE is consumed by transport). The sectors of agriculture, forestry and non-energy uses collectively consume a further ~0.2 MTOE of energy (Table 3-3). The total annual GHGs emitted by the abovementioned sectors and fuel carriers are described further in Section 3.2.

Unless stated otherwise, all energy figures are derived from UN Stats (2014) [10]; World Energy Council (2016); [11]; and the World Resources Institute (2013) [12]. Agriculture & forestry-related emissions are also reported from Food and Agriculture Organisation (2014-2017) [14] and Global Forest Watch. (2015-2017) [15].

3.1.1 National energy production, primary energy supply and national energy consumption

The tables and figures below describe Côte d'Ivoire's energy sector, including total national energy production, primary energy supply and national energy consumption by fuel carrier and sector.

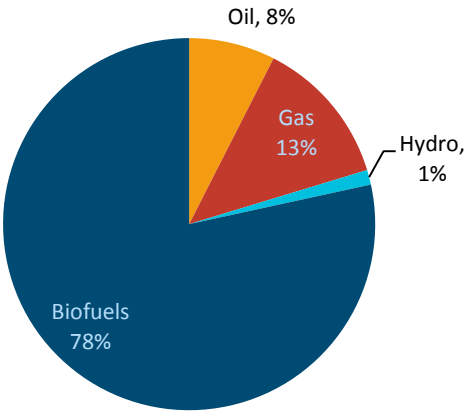


Figure 3-1: Distribution of Côte d'Ivoire's national energy production between major energy carriers (2014-2016)

Table 3-1: National energy and electricity production in Côte d'Ivoire (2014-2016)

NATIONAL ENERGY PRODUCTION		
Source	**Total (MTOE)[1]**	**% of total energy production**
Oil[12]	1.0	7.5
Gas[12]	1.65	12.8
Hydro[12]	0.17	1.28
Biofuels[12]	10.11	78.41
Total national energy production	12.89	
Electricity[6]	Hydro	23.09
	Non-Hydro renewable	0.84
	Oil	6.13
	Gas	69.94

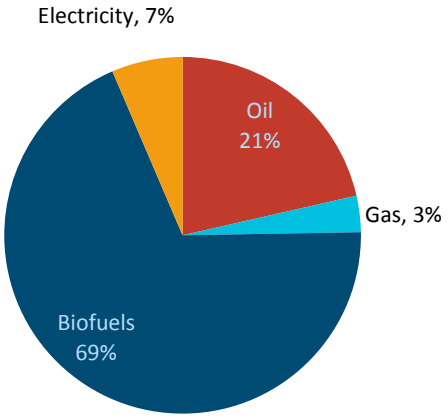


Figure 3-2: Distribution of Côte d'Ivoire's national energy consumption by major energy carriers

Table 3-2: Côte d'Ivoire's national energy consumption by energy source

CONSUMPTION BY ENERGY SOURCE[12]	
Source	**Total (MTOE)**
Oil	1.7
Gas	0.3
Biofuels	5.3
Electricity	0.5
Total national energy consumption by source	7.7

[1] *Energy is expressed in 'Megatonnes of Oil Equivalent', where 1 Tonne Oil Equivalent = 11,630 KiloWatt hours (KWh)*

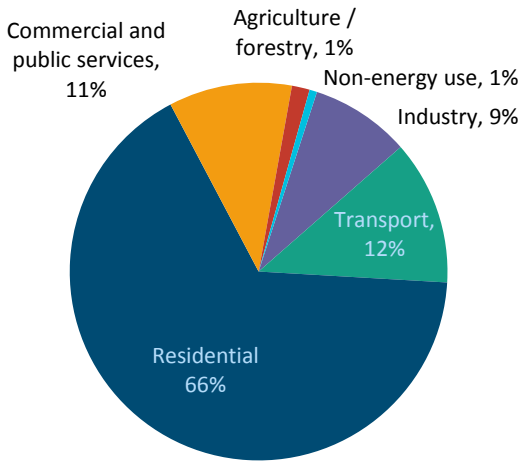


Figure 3-3: Distribution of Côte d'Ivoire's national energy consumption by sector (2014-2016)

Table 3-3: Côte d'Ivoire's national energy consumption by sector (2014-2016)

CONSUMPTION BY SECTOR[12]	
Sector	**Total (MTOE)**
Industry	0.7
Transport	1.0
Residential	5.1
Commercial and public services	0.8
Agriculture / forestry	0.1
Non-energy use	0.1
Total national energy consumption by sector	7.7

Table 3-4: Côte d'Ivoire's national total primary energy supply (estimated for 2014-2016)

TOTAL PRIMARY ENERGY SUPPLY[12]		
Source		**Total (MTOE)**
Oil	Crude Oil	3.5
	Oil Products	-1.5
Gas		1.7
Hydro		0.2
Biofuels		10.1
Electricity		-0.08
Total primary energy supply		13.9

3.2 National greenhouse gas emissions by source and sector

Section 3.2.1, below, describes GHG emissions from fuel combustion - these figures include direct combustion of fuels as a primary energy carrier as well as conversion to other forms of energy (e.g. as electricity). These figures are based on statistics from the International Energy Agency (IEA). Section 3.2.2, further below, describes GHG emissions from all sectors of national energy consumption, which therefore includes emissions from fuel combustion, industrial/manufacturing processes, household-level energy consumption and AFOLU (Agriculture, Forestry and Other Land Use). The latter figures are compiled by the World Resources Institute's Climate Access Indicator Tools (CAIT), which employs different methodologies and reporting standards to the IEA. Therefore, while there is some resultant duplication between the two datasets, each provides slightly different approaches to categorisation of major GHG emitting sectors and are both included for consideration.

Oil and gas are the main contributors to Côte d'Ivoire's greenhouse gas (GHG) emissions from fuel combustion (excluding biomass), contributing ~4.9 MT $C0_2e$ and ~3.8 MT CO2e, respectively (IEA, 2013). The sector that accounts for the largest proportion of national GHG emissions is the energy sector, accounting for total GHG emissions of 13 MT CO_2e from all sources (including

~3.6-3.9 MT CO_2e from direct combustion, ~ 2.7 MT CO_2e from fugitive emissions, ~2.8 MT CO_2e from other fuel combustion such as flaring and 2.6 MT CO_2e from transport of energy resources (Table 3-6).

Following the energy sector, the waste sector is estimated to be at least as large a source of GHGs, contributing up to 13.3 MT CO_2e to Côte d'Ivoire's annual GHG emissions. The sectors of agriculture, land use change and forestry collectively contribute ~10.5 – 11.1 MT CO_2e (Tables 3-6 and 3-7) and finally industrial processes an additional 0.4 MT CO_2e (Table 3-6). Cumulatively, these activities and sectors drive Côte d'Ivoire's total annual GHG emissions from all sectors of ~**37.7** MT CO_2e. Section 3.2.3 provides additional details on Côte d'Ivoire's Land Use and Land Use Change sector, including detailed summaries of emissions from the agriculture sector and historical land use changes.

3.2.1 GHG emissions from fuel combustion, by source and sector

Table 3-5: Côte d'Ivoire's national greenhouse gas emissions from fuel combustion

NATIONAL GHG EMISSIONS FROM FUEL COMBUSTION BY FUEL SOURCE AND SECTOR[13]		
Source / Sector		**Total emissions (MT CO_2e)**
Oil		4.9
Gas		3.8
Total fuel source emissions		8.7
Electricity and heat production		3.9
Other energy industry own use*		0.2
Manufacturing industries and construction		1.1
Transport	Road	2.3
	Other	0.3
	Total	2.6
Other	Residential	0.4
	Non-residential	0.5
	Total	0.9
Total sector emissions		8.7

* Includes emissions from own use in petroleum refining, the manufacture of solid fuels, coal mining, oil and gas extraction and other energy-producing industries.

3.2.2 GHG emissions from primary energy consumption, by source and sector

Table 3-6: Côte d'Ivoire's national greenhouse gas emissions from primary energy consumption (estimated for 2014-2016)

NATIONAL GHG EMISSIONS FROM PRIMARY ENERGY CONSUMPTION BY SOURCE AND SECTOR[14]		
Source / Sector		Total emissions (MT CO_2e)
Energy	Electricity and heat	3.6
	Manufacturing and construction	1.3
	Transport	2.6
	Other fuel combustion	2.8
	Fugitive emissions	2.7
	Energy sub-total	13.0
Industrial processes		0.4
Agriculture		5.3
Waste		13.3
Land use change and forestry (LUCF)		5.8
Total emissions (including LUCF)		37.7

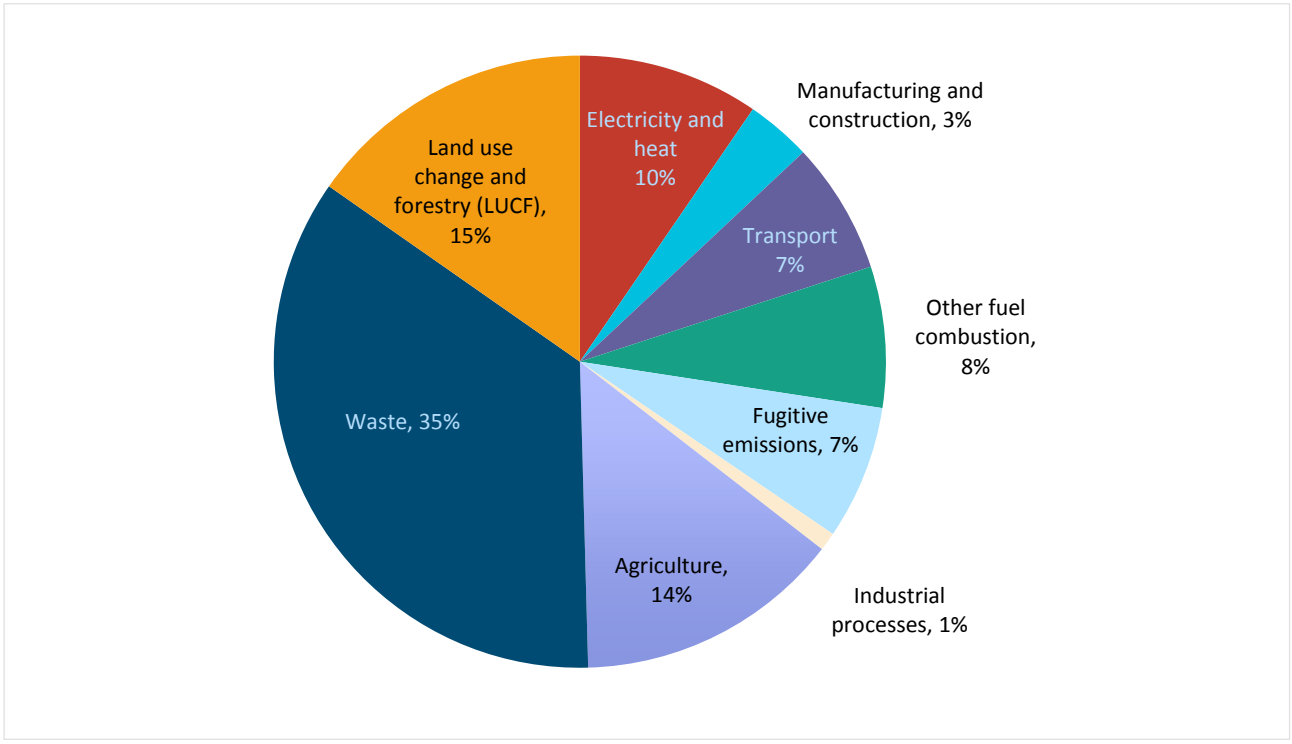


Figure 3-4: Distribution of Côte d'Ivoire's GHG emissions by major sectors

3.2.3 GHG emissions from agricultural practices

Côte d'Ivoire's total annual GHG emissions from the sectors of agriculture, forestry and land use change contribute ~10.3-11.1 MT CO_2e (Tables 3-6 – 3-7). Table 3-7, below, estimates the activity-level emissions within these sectors. The agriculture sector, which contributes emissions of 4.8 MT CO_2e includes emissions

of ~3.3 MT CO_2e from activities related to manure management in the livestock sector. Crop production generates emissions of 1.5 MT CO_2e of which 0.8 is contributed by burning of savanna, 0.3 MT CO_2e from synthetic fertilisers, and 0.2 MT CO_2e each from crop residues, rice cultivation and cultivation of organic soils.

Emissions from land use change, totalling 5.5 MT CO_2e, include 3.7 MT CO_2e from forest land and 1.7 MT CO_2e from cropland, respectively – activities in these areas include clearance for expansion of new farmlands, harvesting of woody biomass as domestic fuel and removal of timber by the commercial forestry sector. Table 3-8, below, provides further detail on emissions from the land use change and forestry sector in Côte d'Ivoire.

Table 3-7: National annual greenhouse gas emissions from agricultural practice, forestry and other land use in Côte d'Ivoire (estimated for 2014-2017)

VARIABLE		ANNUAL EMISSIONS (MT CO_2E)
Annual GHG emission from agricultural practices[15]	Burning - crop residues	0.0
	Burning - savanna	0.8
	Crop residues	0.2
	Cultivation of organic soils	0.2
	Enteric fermentation	1.5
	Manure management	0.2
	Manure applied to soils	0.1
	Manure left on pasture	1.3
	Rice cultivation	0.2
	Synthetic fertilizers	0.3
	Sub-total (Agricultural practices)	4.8
Annual GHG emission from land use change[15]	Grassland	0.1
	Cropland	1.7
	Forest land	3.7
	Burning biomass	0.0
	Sub-total (Land use change)	5.5
Total emissions		10.3

Table 3-8, below, summarises the distribution of land cover and recent historical changes in land use in Côte d'Ivoire through analysis of land use change. Statistics derived from the Global Forest Watch database were used to summarise the total area of wooded vegetation in various categories of canopy cover density (where 10-30% canopy cover can be considered as savanna, 30-50% cover can be considered woodland and 50-100% cover can be considered dense forest), as well as the historical rates of change in each vegetation category.

Côte d'Ivoire has extensive forestry and woodland areas, cumulatively covering ~87.8% of the country. This includes 4.97 million hectares of the densest class of tropical forest (50-100% canopy cover) and 7.9 million hectares of '30-50% canopy' forests, while the remaining ~15.4 million hectares is classified as '10-30% canopy' (the latter category largely occurring as savanna woodland). Global Forest Watch reports the total aboveground carbon stock of Côte d'Ivoire's forest biomass as ~1.838 million tonnes.

Table 3-8: Vegetation cover and land use change in Côte d'Ivoire (estimated for 2015)

VARIABLE			TOTAL (HECTARES)	TOTAL (% OF LAND AREA)	UNIT
Total tree cover[16]	10-30% canopy cover		15,436,342	47.87	% of total land area
	30-50% canopy cover		7,897,488	24.5	
	50-100% canopy cover		4,971,295	15.4	
	Total		28,305,125	87.8	
Land use change and agricultural expansion	Historical annual rate of deforestation[17]	10-30% canopy cover		0.2	% of previous year
		30-50% canopy cover		0.4	
		50-100% canopy cover		1.3	
	Area of agricultural land[18]		20,788,996	64.5	% of total land area

4. SUMMARISED NATIONAL PRIORITIES FOR CLIMATE CHANGE ADAPTATION AND MITIGATION

Côte d'Ivoire's main priority actions related to climate change are described in the country's submissions to the UNFCCC through the Intended Nationally Determined Contributions (NDC) document. The document includes detailed descriptions of the country's major commitments and priorities related to GHG mitigations (Table 4-2, below) as well as major priorities related to adaptation, derived from the draft National Adaptation Plan (NAP) (Table 4-3, further below).

Côte d'Ivoire's NDC indicates a reduction target of 28% in GHG emissions compared to emissions in the target year (2030) in a baseline scenario (BAU or Business As Usual).

The NDC includes basic indicative costs of proposed mitigation actions in the areas of AFOLU and energy/transport, respectively. The total costs of the National Agricultural Investment Plan, which includes both adaptation and mitigation components, is anticipated to require investments of ~522 billion FCFA per year (~USD 936 million). Further, the NDC estimates that the Master Plan for the Production and Transport of Electric Power 2014-2030 calls for an investment of ~8,000 billion FCFA (USD 14.3 billion) in the period 2014-2030, with additional investments in the mining sector costing ~1,600 billion FCFA (USD 2.87 billion).

With respect to proposed adaptation actions, Cote D'Ivoire's NDC provides preliminary cost estimates for priority projects in the areas of water resource management (~USD 70.3 million), strengthening production of agriculture forestry and fisheries (~USD 1.586 billion), fighting deforestation and land degradation (~USD 29.1 million) and fighting coastal erosion (~USD 72.1).

Table 4-1, below, gives details on Côte d'Ivoire's GHG reduction targets outlined in the country's NDC, with information on target gases and sectors, the use of international markets in achieving targets (e.g. the use of carbon credits), and accounting methods used to quantify GHG emissions (e.g. inclusion of land use and land use change).

Table 4-1: Summary of Côte d'Ivoire's NDC commitments for reduction of GHG emissions

GHG EMISSIONS REPORTED IN NDC (MT CO_2E/YR)	BASE LEVEL	REDUCTION TARGET	TARGET YEAR	SECTORS AND GASES	USE OF INTERNATIONAL MARKETS	LAND-USE INCLUSION / ACCOUNTING METHOD
35.78	BAU	28 percent (unconditional)	2030	CO_2, CH_4, N_2O; Energy, agriculture, land-use, land-use change and forestry, waste	Not mentioned	Forestry included, accounting methodology not specified.

4.1 National priorities for climate change mitigation

As described in Section 1 and Section 3 (above), Côte d'Ivoire's economy is relatively diverse and includes well-developed agricultural and forestry sectors, extensive fossil fuel production and consumption and acts as a regional hub for services and transport. Consequently, the country's NDC identifies detailed mitigation priorities and actions for important economic sectors including energy, the AFOLU (Agriculture, Forestry and Other Land Use), transport, and waste management. Proposed activities and investments within each sector are further categorised according to 'Technology Type', based on the categories of technologies listed by the Green Climate Fund's (GCF) impact indicators for mitigation projects (key for technology types provided below Table 4-2)

With respect to Côte d'Ivoire's proposed activities to mitigate against climate change through the AFOLU sector, major themes include inter alia detailed measures to reduce deforestation and forest degradation resulting from forestry, agriculture and woodfuel collection by implementation of improved national planning and management of rural areas to

develop the agriculture and forestry sectors. In addition, the NDC's priorities identify actions to reduce emissions from specific sources of GHG emissions such as cultivation of organic soils, emission of methane from flooded rice cultivation, and application of synthetic fertilisers. Multiple integrated measures are proposed to support the increased protection and restoration of vulnerable or degraded forest areas, including inter alia through implementation of a national REDD+ program, reclassification of protected areas and establishment of systems for participatory/community-based management of forests. Conservation and restoration of natural forests through establishment of a payment incentive system for environmental services (Paiement pour service environnementaux, PSE) is also proposed to encourage support small producers to adopt sustainable production practices and reduce emissions from land use change.

With respect to the energy sector (which is strongly interdependent on the AFOLU sector as a major source of biomass fuel), Côte d'Ivoire's proposed NDC mitigation actions include diverse and detailed measures to reduce emissions, including both through development/promotion of alternative energy sources and as well as through increased efficiency in generation and distribution of energy. Policy-level measures proposed for Côte d'Ivoire's energy sector aim to establish "increased energy efficiency and increased contribution of renewal energy to the electrical mix by 2030", including establishment of an enabling institutional environment and legal framework and dedicated agency for promotion of renewable and efficient energies. Energy technologies identified for further investigation and development in Côte d'Ivoire's NDCs include inter alia micro-hydroelectricity; methanisation (recovery of methane from waste and agricultural residues), solar photovoltaic kits; and efficient biomass energy use.

Mitigation priorities identified for Côte d'Ivoire's transport sector are based on reducing emissions from vehicles by enforcement of increased standards of efficiency and on reduced traffic congestion through improved and efficient design of urban infrastructure. Promotion and development of 'low-carbon transport' is noted as a possible measure, however no additional details on low-carbon transport options are cited.

Table 4-2: Mitigation priorities in Côte d'Ivoire's NDC

PRIORITY SECTOR	SECTOR SPECIFIC ACTION	TECHNOLOGY TYPE[2]
AFOLU	Implementation of "Plan Nationaux d'Investissement Agricole" with strategies to limit deforestation (REDD+ processes) through a master plan for land use planning in 2030 in consultation with each of the agricultural sectors and lands Drafting of a regional land use planning scheme for different regions with the involvement of local communities	4, 9
	Delimitation of village territories and establishment of limits with tree species	
	Securing land tenure with the involvement of agriculture, cooperatives and the private sector, to facilitate procedures and achieve economies of scale.	

[2] *GCF Technology Type Key (derived from GCF's Results Framework for mitigation)*

1. Reduced emissions through increased lower emission energy access and power generation.

2. Reduced emissions through increased access to low-emission transport.

3. Reduced emissions from buildings, cities, industries and appliances.

4. Reduced emissions from land use, deforestation, forest degradation, and through sustainable management of forests and conservation and enhancement of forest carbon stocks.

5. Strengthened institutional and regulatory systems for low-emission planning and development.

6. Increased number of small, medium and large low-emission power suppliers.

7. Lower energy intensity of buildings, cities, industries, and appliances.

8. Increased use of low-carbon transport.

9. Improved management of land or forest areas contributing to emissions reductions.

PRIORITY SECTOR	SECTOR SPECIFIC ACTION	TECHNOLOGY TYPE[2]
	Decoupling of agricultural production and deforestation through the promotion of intensive agricultural practices with reduced impact on the environment and agroforestry	
	Implementation of the concept "Agriculture zero deforestation" and development of associated products	
	Development of basic infrastructure to improve transport logistics of agricultural, livestock and aquaculture products	
	Rationalization of the use of chemical inputs and facilitation of the use of biological inputs	9
	Development of efficient mechanization of agriculture and improvement of packaging, harvesting and conservation infrastructures	
	Promotion of the agriculture-livestock association, agroforestry, and conservation agriculture, especially at the level of community and private plantations	
	Maximum reduction of rice submersion to limit methane emissions	9
	Sustainable management of organic soils	9
	Strengthening and popularizing the results of scientific research on natural resource management (including soil sciences and pathology physiology and post-harvest technology)	
	Improvement of cropping schedules and production techniques	
	Implementation of "Applications des réglementations forestières, Gouvernance et Echanges commerciaux (FLEGT)" (Forest Regulatory Applications, Governance and Trade)	4
	Drafting and implementation of plans for the management and participatory management of classified forests	4, 9
	Stabilization of the extension of agricultural areas in classified forests	
	Restoration of classified forests with the involvement of local communities	
	Strengthening the sustainable management of classified forests and protected areas, especially through spatial land monitoring	
	Facilitating rehabilitation of degraded lands and reforestation in savannah areas, and strengthening carbon stocks in degraded forests through the promotion of village reforestation	
	Establishment of a payment incentive system for environmental services (Paiement pour service environnementaux, PSE) to encourage village reforestation and conservation of natural forests in rural areas and support small producers to adopt sustainable production practices	
	Reforestation with fast-growing species for wood energy; promotion of improved stoves and promotion of charcoal alternatives through the promotion of agricultural biomass	

PRIORITY SECTOR	SECTOR SPECIFIC ACTION	TECHNOLOGY TYPE[2]
Energy	Investment in energy efficiency and increased contribution of renewal energy to the electrical mix by 2030	1, 7
	Establishment of an institutional and regulatory framework for renewable energies and energy efficiency	1
	Strengthening the integration of Côte d'Ivoire into the Regional Energy Market, through interconnection with other countries in the region	1
	Implementation of a strategy to reduce waste from energy consumption through: - Diagnosis or energy audit to establish a balance of consumption and energy use; - counting to have reliable and continuous data on - consumption.	1, 3, 7
	Encourage companies to invest in energy-efficient equipment	1, 3
	Evaluate potential for substitution or optimization (e.g cogeneration or recovery);	1, 3
	Development of national regulations on the thermal efficiency of buildings (construction and renovation)	1, 3, 7
	Training of all players in the low-energy construction value chain	
	Establish an incentive framework for the development of renewable energies (tender, ITF, tax exemption, etc.)	
	Removing barriers to investment (strengthening the institutional framework, securing investments, training banks, etc.)	
	Investing in R & D, notably by strengthening the capacity of the Renewable Energy Research Institute (IREN) and assessing the opportunity creating an Agency for the Promotion of Renewable Energies	
	Facilitate the development of projects in relevant sectors: - Small hydroelectricity - Methanisation (waste, agricultural residues ...) - Photovoltaic (promotion of solar PV kits, PV pumping system ...) - Biomass (sustainable use of wood energy)	
Transport	Improved mobility and development of low-carbon transport	2, 8
	Integration of an energy / climate dimension into land use planning documents in order to limit distances, work on functional mix and propose efficient transit policies	2, 5, 8
	Inclusion of municipalities in the preparation of urban transport plans (e.g. urban train in the district of Abidjan)	2, 5, 8
	Facilitating the purchase of low-emission vehicles and scrapping of the most polluting by standards, incentives or obligations	2, 5, 8
Waste	Develop and implement a policy and strategy for the sustainable management of waste including valuation	5, 7

PRIORITY SECTOR	SECTOR SPECIFIC ACTION	TECHNOLOGY TYPE[2]
	Develop circular economy measures: - Eco-design of products - Waste recovery / use and recycling (agricultural, forestry and household) - Composting - Wastewater evaluation	

4.2 National priorities for climate change adaptation

Côte d'Ivoire's national priorities for climate change adaptation are described in the country's NDC, including identification of measures for the sectors of water, AFOLU, energy and coastal zones. Proposed activities and investments related to adaptation are further categorised according to 'Technology Type', based on the categories of technologies listed by the Green Climate Fund's (GCF) impact indicators for adaptation projects (key for technology types provided below Table 4-3).

The adaptation measures identified for the agriculture/AFOLU sector address the vulnerability of rural households' dependent on agriculture and livestock as a source of livelihood while aiming to reduce degradation and negative impacts on natural resources that provide provisioning services. Therefore, adaptation actions identified for Côte d'Ivoire's AFOLU sector are based on: i) strengthening agricultural, livestock and fisheries production; ii) fighting deforestation and land degradation; and iii) promotion of reforestation and agro-ecology, restoring degraded lands, techniques for improving soil fertility, and soil conservation. In recognition of the close link between the AFOLU and energy sectors (which is partly based on use of biomass fuel from farm and forest areas), Côte d'Ivoire's adaptation priorities for the energy sector are aligned with the AFOLU sector and aims to reduce the negative environmental impacts of woodfuel collection and deforestation (for example, deforestation results in loss of topsoil, silting of streams and rivers) by organising the wood energy sector and promoting the use of efficient/improved woodfuel stoves. Côte d'Ivoire's adaptation priorities for the water sector are also closely aligned with the AFOLU sector, noting the need to introduce improved management of water resources by measures including strengthening of watershed planning and coordination, development of agro-pastoral dams, development of new hydro-agricultural and reservoir sites, and improvement of irrigation efficiency.

As a coastal country with a large proportion of the population living adjacent to the coastline, Côte d'Ivoire's NDC notes the need to protect the country's coastline and infrastructure from increased coastal erosion. Measures proposed for the coastal areas include actions to regulate the construction structure (aimed at controlling unregulated sand mining), to relocate and reconstruct vulnerable infrastructure and ongoing works, construction of active protection (e.g. breakwaters), passive protection and restoration (wind curtains, revegetation, and reforestation of mangroves).

Table 4-3: Adaptation priorities in Côte d'Ivoire's NDC

PRIORITY SECTOR	SECTOR-SPECIFIC ACTION	TECHNOLOGY TYPE[3]
Water	Control and management of water resources (strengthening of watershed planning and coordination, development of agro-pastoral dams, development of new hydro-agricultural and reservoir sites, improvement of irrigation efficiency, evaluation of	4, 5

[3] **GCF Technology Type Key (derived from GCF's Results Framework for adaptation)*

1. Increased resilience and enhanced livelihoods of the most vulnerable people, communities, and regions.

2. Increased resilience of health and wellbeing, and food and water security

3. Increased resilience of infrastructure and the built environment to climate change threats

4. Improved resilience of ecosystems and ecosystem services

5. Strengthened institutional and regulatory systems for climate responsive planning and development

PRIORITY SECTOR	SECTOR-SPECIFIC ACTION	TECHNOLOGY TYPE[3]
	Storm water and floods.	
AFOLU	Strengthen agricultural, livestock and fisheries production (agricultural sector 23% of GDP over the period 2000-2013)	4
	Fighting deforestation and land degradation	4
	Improving silvicultural species, promoting reforestation and agro-ecology, restoring degraded lands, promoting techniques for improving soil fertility and soil conservation	4
Coastal	Building resilience in particular through the fight against coastal erosion	3, 4
	To regulate the construction and extraction of sand on the coast, to relocate and reconstruct the works in danger on a fall back line, to construct active protection (ears, breakwaters), passive protection and restoration (wind curtains, revegetation, reforestation-mangroves)	4, 5
Energy	Organize the wood-energy sector, avoid the silting of streams, to reprofile and to restore the flows in the minor beds of the rivers. Popularizing the construction and use of improved fireplaces in rural areas	5

6. Increased generation and use of climate information in decision making
7. Strengthened adaptive capacity and reduced exposure to climate risks
8. Strengthened awareness of climate threats and risk reduction processes

5. ASSUMPTIONS, GAPS IN INFORMATION AND DATA, DISCLAIMERS

The observed and projected climate trends described in Section 2 'Climate and Weather' are derived from a combination of publicly-available observational data and CMIP5 climate models. Detailed information is included in Section 6. Appendix 1, including '6.1.b. Historical Trends and Variability Analysis' and '6.1.c. Climate Projections Visualisations'.

Unless stated otherwise, all statistics reported in Section 1 ('Geographic and Socio-Economic Context' and Section 3 'Climate change mitigation, greenhouse gas emissions and energy use') are derived from databases of publicly available datasets managed by international or multilateral agencies including inter alia The World Bank Group, the United Nations, World Resources Institute and International Energy Agency.

Unless stated otherwise, all energy and greenhouse gas emission figures are derived from UN Stats (2014); World Energy Council (2016); the World Resources Institute (2013), and the International Energy Agency (2016). Agriculture & forestry-related emissions are also reported from Food and Agriculture Organisation (2014-2017) and Global Forest Watch. (2015-2017). Full references are provided as a supplementary appendix.

As a result of the use of standardised methodologies and data sources across the 25 countries included in this AfDB Climate Change Profile, statistics and estimates reported herein may differ from other publicly available datasets or national estimates. Readers are advised to always check for updated publications and newly released national datasets.

This AfDB Climate Change Profile series is intended to provide a brief touch-stone reference for climate change practitioners, project managers and researchers working in African countries. The figures and estimates provided herein are intended to inform the reader of the main climate-related challenges and priorities, however these should be used to inform a process of additional research and in-country consultations. The University of Cape Town, the African Development Bank and its Boards of Directors do not guarantee the accuracy of figures and statements included in this work and accept no responsibility for any consequences of its use.

6. APPENDIX 1

1.a Supporting evidence

The climate projections detailed in Chapter 2 (above) are supported by rigorous analysis of observed and model projections data. More details of this analysis and supporting figures can be found below.

1.b Historical trends and variability analysis

The analysis of historical trends and variability of key climate variables is presented below. This analysis uses the WATCH Climate Forcing dataset which has been selected as the most broadly representative of station observations across Côte d'Ivoire. Long term (1979 to 2013) trends as well as inter-annual variability (decade to decade) has been analysed for total annual rainfall, number of rainfall days, number of extreme rainfall days, and daily mean temperatures (1979-2014) for each of the three climate regions across Côte d'Ivoire. The plots below detail **inter-annual variability** (dotted lines), **decadal variability** (smooth bold solid curves) and **long term trends** (thin straight lines) for each region and statistic. This allows for comparison of different types of variability against the long term trend. It can be seen that for rainfall statistics, inter-annual and decadal variability are typically fairly large compared to long term trends. For example, for total annual rainfall, the Central region has very high inter-annual (1000mm in some years to 1700mm in other years) and moderate decadal variability (1300mm in some decades to 1500mm in other decades). Long term trends are not statistically significant but could be around -12mm over the 30 year period.

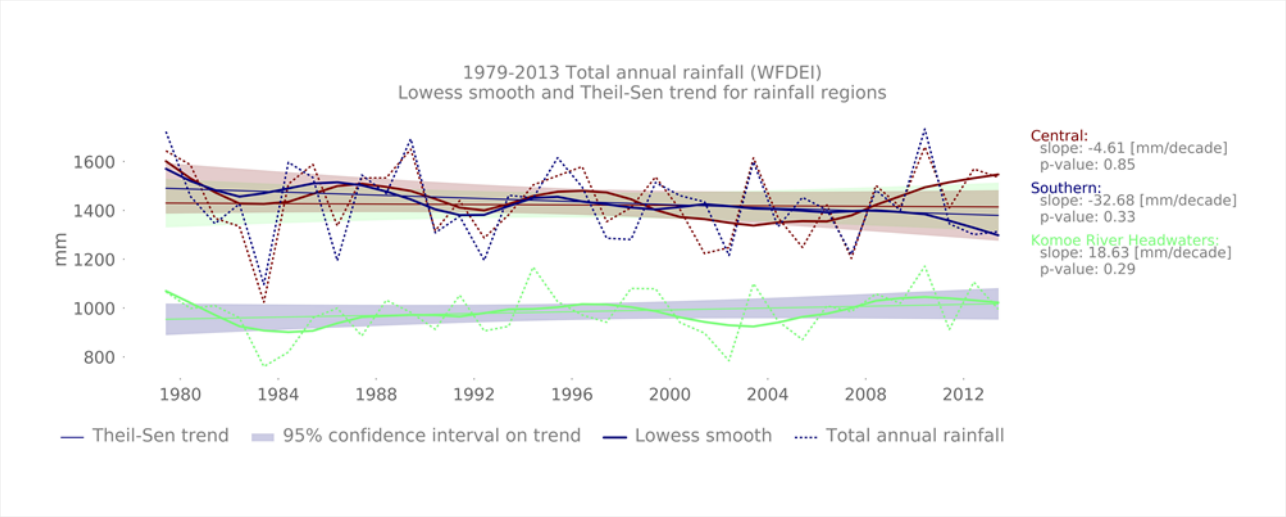


Figure A-1: Long term trends and variability in total annual rainfall for rainfall regions

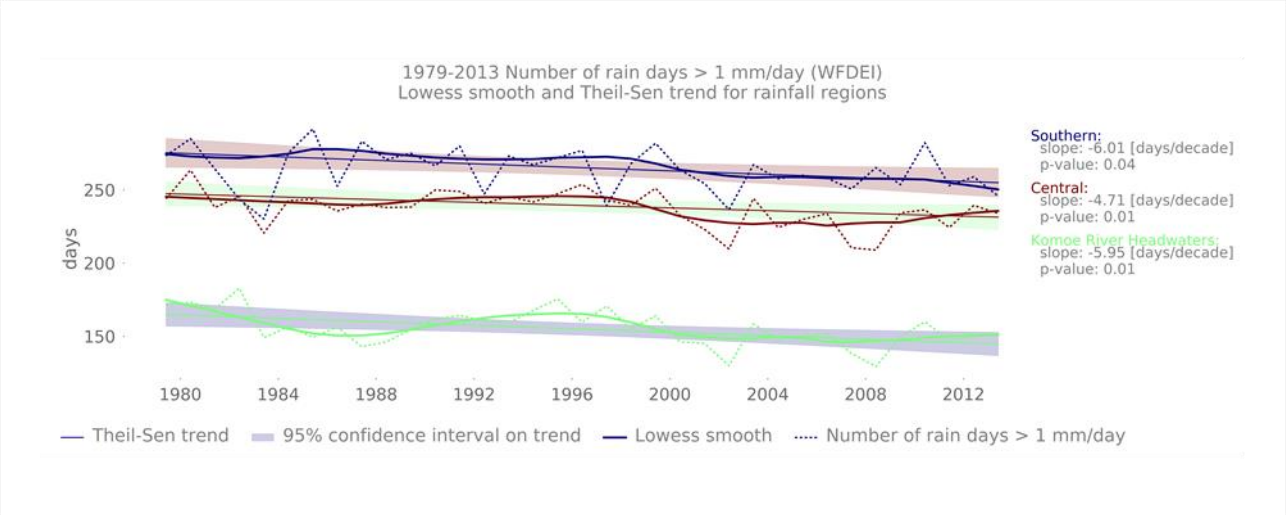


Figure A-2: Long term trends and variability in frequency of rainfall events for rainfall regions

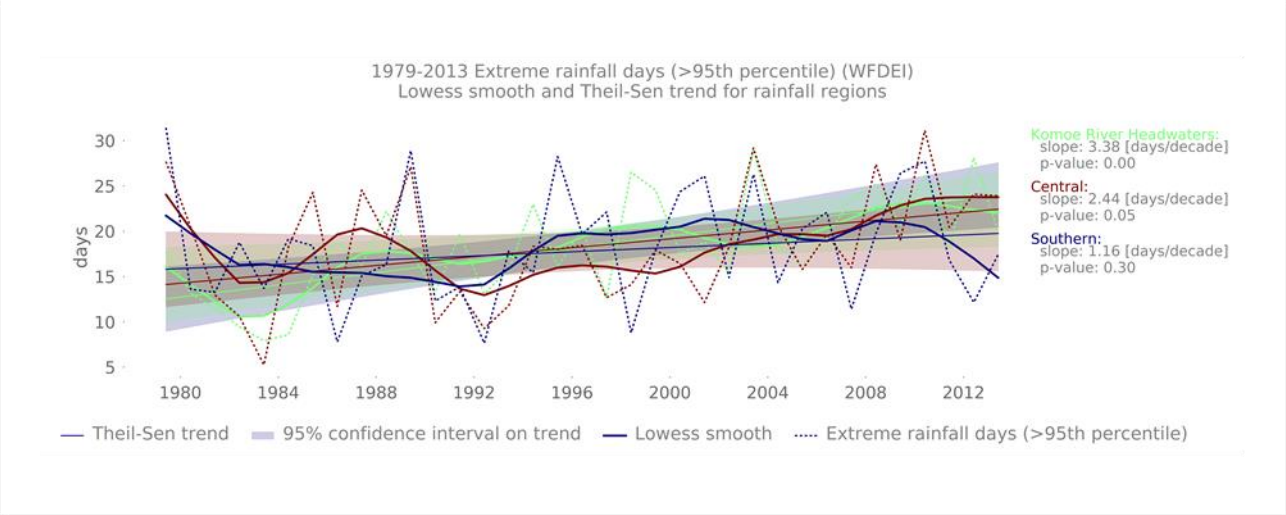


Figure A-3: Long term trends and variability in extreme rainfall events for rainfall regions

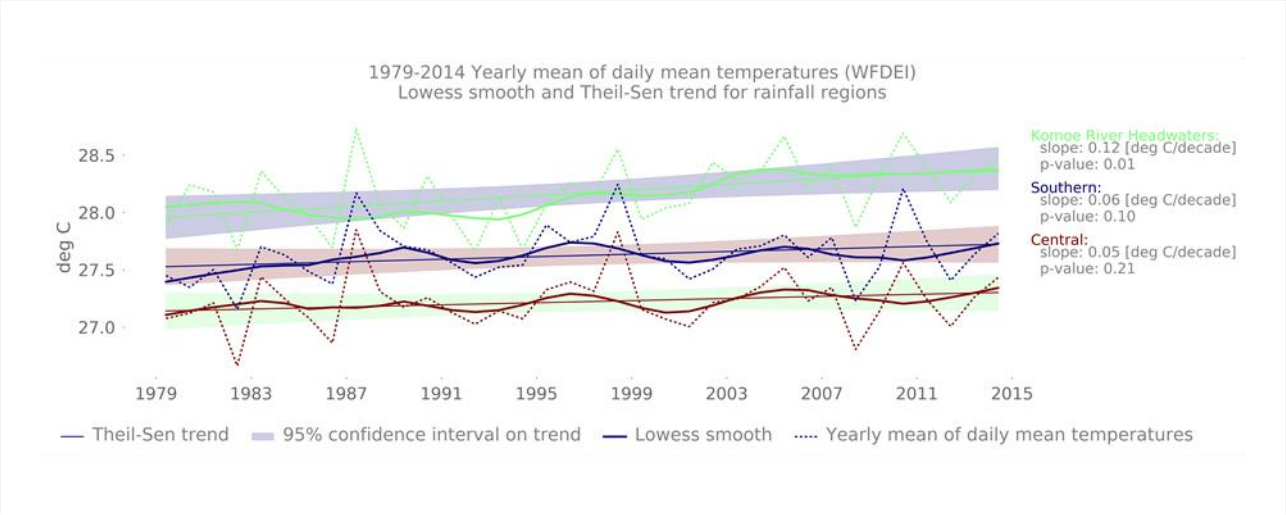


Figure A-4: Long term trends and variability in daily mean air temperatures for rainfall regions

1.c Climate projections visualizations

The plots below (Figures A-5 – A-8) are called plume plots and they are used to represent the different long term projections across the multiple climate models in the CMIP5 model archive used to inform the IPCC AR5 report. The plots show projected variations in different variables averaged over the climate regions. The blue colours indicate variations that would be considered within the range of natural variability, so in other words, not necessarily the result of climate change. The orange colours indicate projection time series where the changes would be considered outside of the range of natural variability and so likely a response to climate change. It is important to note that these are global climate model projections and so likely do not capture local scale features such as topography and land ocean boundary dynamics. They also may not capture small scale features such as severe thunderstorms that can have important societal impacts. Finally, these projections are averages over relatively large spatial areas and it is possible that different messages would be obtained at small spatial scales and if various forms of downscaling are performed.

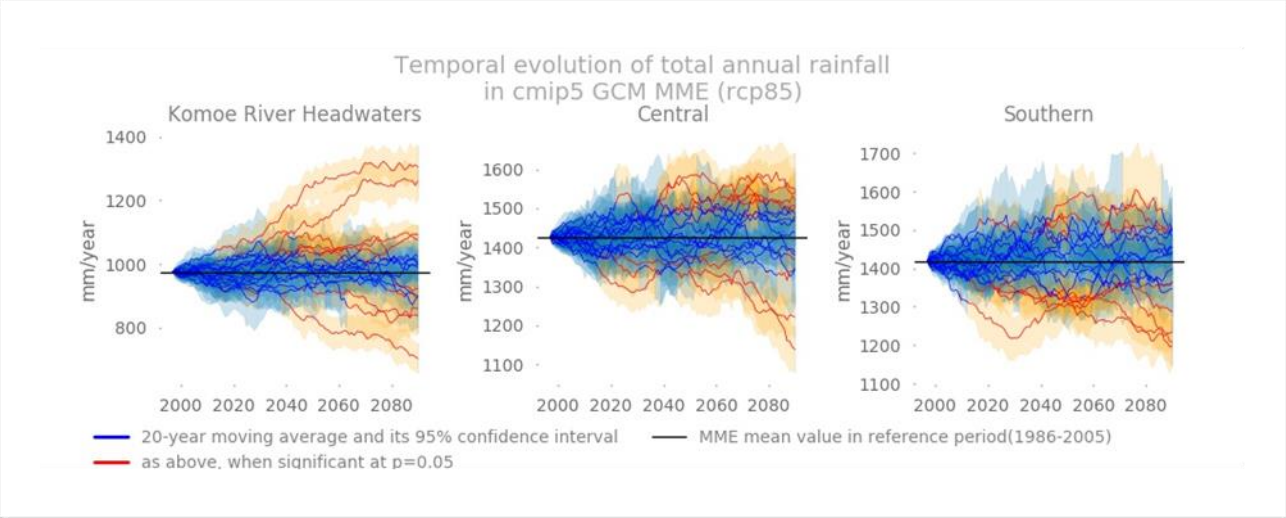


Figure A-5: Projected changes and emergence of changes in total annual rainfall

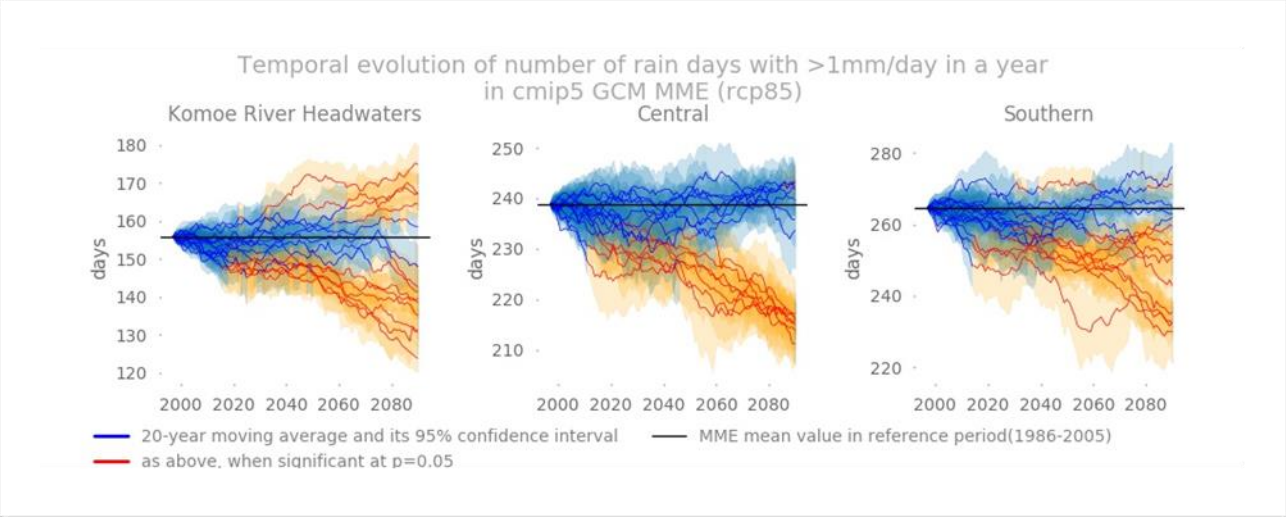


Figure A-6: Projected changes and emergence of changes in number of rain days per year

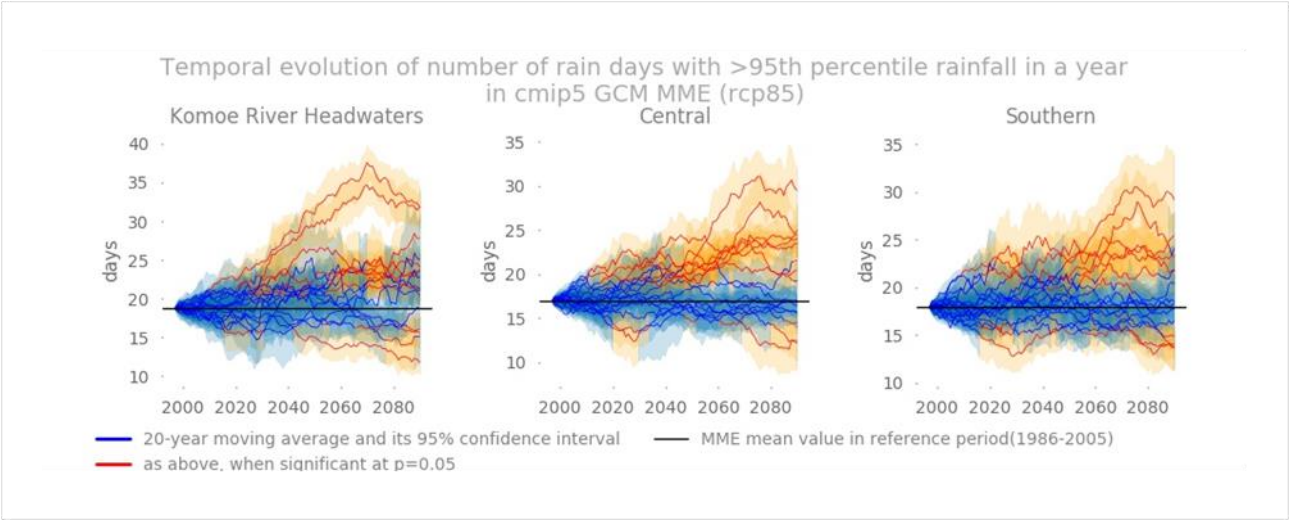


Figure A-7: Projected changes and emergence of changes in number of very heavy rainfall days (greater than 95th percentile) per year

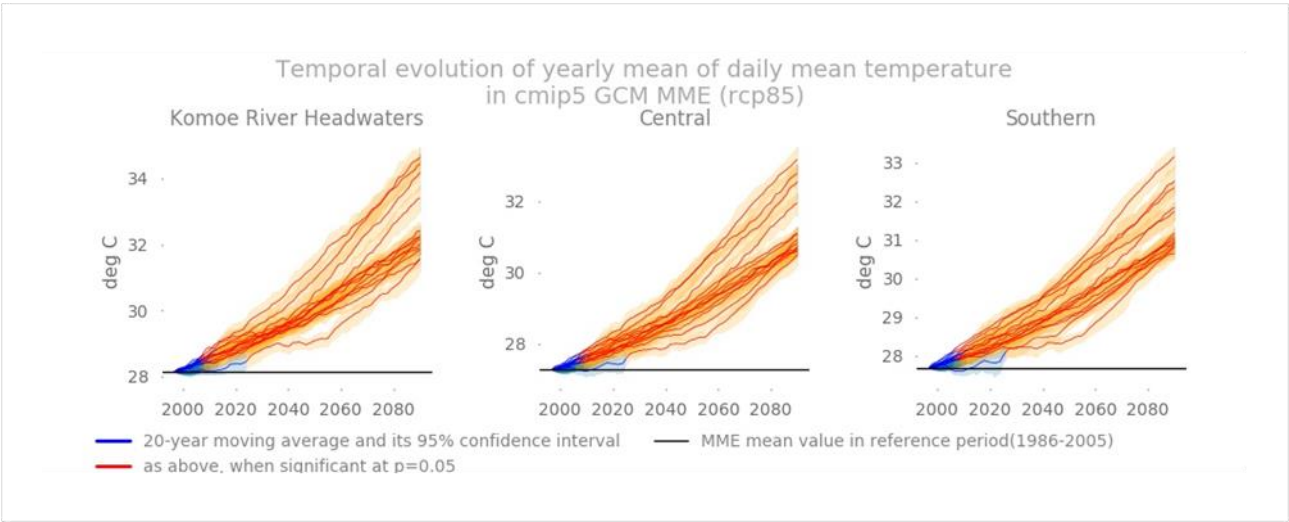


Figure A-8: Projected changes and emergence of changes in annual mean daily mean temperatures