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Collaborative Adaptation Research Initiative in Africa and Asia

Review of Current and Planned Adaptation Action in Senegal

CARIAA Working Paper #18

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About CARIAA Working Papers

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Titles in this series are intended to share initial findings and lessons from research and background studies commissioned by the program. Papers are intended to foster exchange and dialogue within science and policy circles concerned with climate change adaptation in vulnerability hotspots. As an interim output of the CARIAA program, they have not undergone an external review process. Opinions stated are those of the author(s) and do not necessarily reflect the policies or opinions of IDRC, DFID, or partners. Feedback is welcomed as a means to strengthen these works: some may later be revised for peer-reviewed publication.

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Abstract

Climate change presents a significant challenge for Senegal as it strives to transform its economy, create jobs, achieve social solidarity, and conserve its natural resources. The country's long coastline exposes its rapidly growing coastal population to sea level rise, and its arid areas, already affected by prolonged dry periods, are likely to be further affected by rising temperatures and rainfall variability. The high dependence of Senegalese on climate-sensitive livelihoods such as agriculture, livestock raising, and fishing increases their vulnerability. Responding to these risks, Senegal has prioritized adaptation actions in its coastal and northern areas, and in its water resources, agriculture, fisheries, health, and tourism sectors. Specific adaptation actions are under way throughout the country that target resilience-building needs in the areas of agriculture, climate information, coastal zone management, and disaster risk management. More limited efforts appear to be focused on its tourism and health sectors. The government has begun to consider climate change as a risk in its medium- and long-term development strategies and plans, as well as its sectoral plans, and has established climate change coordinating committees at the national and regional levels. However, progress has been modest and greater effort is needed to mainstream climate change into development planning at the national and subnational levels. These issues are explored more fully in this report, which is part of a series of country reviews prepared to provide the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA) with a snapshot of adaptation action in its countries of engagement.

Résumé

Examen des mesures d'adaptation actuelles et prévues au Sénégal

Les changements climatiques présentent un défi de taille au Sénégal, qui fait tout son possible pour transformer son économie, créer des emplois, instaurer la solidarité sociale et conserver ses ressources naturelles. Le long littoral du Sénégal, qui abrite des villages côtiers dont la population s'accroît rapidement, est exposé à une élévation du niveau de la mer, et les régions arides du pays, déjà touchées par de longues périodes de sécheresse, sont probablement appelées à subir les effets de la hausse des températures et de la variabilité des précipitations. La grande dépendance de la population sénégalaise envers des moyens de subsistance sensibles au climat comme l'agriculture, l'élevage et la pêche accroît sa vulnérabilité. Pour faire face à ces risques, le Sénégal a ciblé les mesures d'adaptation sur les zones du littoral et du nord, ainsi que sur les secteurs des ressources en eau, de l'agriculture, de la pêche, de la santé et du tourisme. Des mesures d'adaptation particulières sont prises à l'échelle du pays. Elles visent à répondre aux besoins d'amélioration de la résilience dans les domaines de l'agriculture, de l'information sur le climat, de la gestion des zones côtières et de la gestion des risques de catastrophe. Les efforts consacrés aux secteurs du tourisme et de la santé semblent plus limités. Le gouvernement a commencé à considérer les changements climatiques comme un risque dans ses stratégies et ses plans de développement à moyen et long terme ainsi que dans ses plans sectoriels, et il a mis sur pied des comités de coordination sur les changements climatiques aux niveaux national et régional. Les progrès ont toutefois été modestes et des efforts plus importants sont nécessaires pour intégrer les changements climatiques à la planification du développement aux niveaux national et infranational. Ces questions sont examinées plus en détail dans ce rapport, qui s'inscrit dans une série d'examens de pays menés dans le cadre de l'Initiative de recherche concertée sur l'adaptation en Afrique et en Asie (IRCAAA), pour donner un aperçu des mesures d'adaptation dans les pays où elle est déployée.

Acronyms

CARIAA	Collaborative Adaptation Research Initiative in Africa and Asia
CCAFS	Climate Change, Adaptation and Food Security
CIA	Central Intelligence Agency
COMNACC	Comité national sur les Changements climatiques (National Climate Change Committee)
COMRECC	Comité régionaux sur les Changements climatiques (Regional Climate Change Committee)
DFID	Department for International Development (UK)
ENDA-TM	Enda Tiers Monde (Environment Development Action in the Third World)
FAO	Food and Agriculture Organization
GOS	Government of Senegal
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
LDCF	Least Developed Countries Fund
MDG	Millennium Development Goal
MEDD	Ministère de l'Environnement et du Développement Durable (Ministry of Environment and Sustainable Development; formerly Ministry of Environment and Nature Protection)
MEPN	Ministère de l'Environnement et de la Protection de la Nature (Ministry of Environment and Nature Protection)
NAP	National Adaptation Plan
NAPA	National Adaptation Programmes of Action
ND-GAIN	Notre Dame Global Adaptation Index
OECD	Organisation for Economic Co-operation and Development
PSE	Plan Sénégal Émergent (Emerging Senegal Plan)

REPES	Réseau des Parlementaires pour la Protection de l'Environnement au Sénégal (Parliamentary Network for Environmental Protection in Senegal)
SNDES	Stratégie Nationale de Développement Economique et Sociale (National Strategy for Economic and Social Development)
SNMO	Stratégie Nationale Initiale de Mise en Œuvre de la Convention Cadre des Nations Unies sur les Changements Climatiques (National Strategy to Implement the United Nations Framework Convention on Climate Change)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

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Contents

Synopsis

Climate risks	• Rising temperatures • Sea level rise, oceanic temperature rise, and coastal erosion • Changing rainfall patterns, although projections remain uncertain; tendency for less predictability in the start and end of rainy seasons	**Key sources of vulnerability**	• Nearly 70% of Senegalese live in multi-dimensional poverty • Agriculture sector is mainly rain-fed, the source of employment for a large share of the population, and a main source of export earnings • Fishing is key sector • Most Senegalese live along the country's long coastline • Poor sanitation systems

Vulnerable sectors	Illustrative potential impacts on vulnerable sectors	Illustrative priority adaptation measures in each sector	Projects in sector[1]
Water	• Changes in rainfall patterns could reduce river runoff • Saline water intrusion, leading to loss of vegetation and mangroves • Projected decreases in groundwater levels by 5 metres to 10 metres by 2100	• Establish infrastructure to decrease water losses into the sea • Ensure early treatment of polluted water and establish water purification systems • Improve education and raise awareness • Introduce rainwater harvesting	10%
Agriculture	• Saline water intrusion due to sea level rise will degrade soils • Livestock and milk production negatively affected through loss of fodder and diminished water availability • Increased pest and disease incidence	• Develop agroforestry practices and expand community forests • Promote crop diversification and selection of crops tolerant to extreme climatic conditions • Improve water management and promote water reuse • Reorganize livestock breeding practices • Implement early-alert system in rural areas	30%
Coastal zones	• Sea level rise will increase flooding of low-lying coastal areas, damage infrastructure, and affect the tourism sector • Sea level rise will also increase saline intrusion in surface water, groundwater, and soils, reducing the availability of potable water and affecting agriculture • Reduction of fish reproduction zones	• Improve land planning in coastal towns • Establish an institutional structure in charge of coastal zoning and strictly define the coastal development zone • Increase information dissemination • Establish protections for different ecosystems and species	10%

[1] Percentage of total identified discrete adaptation projects and programs based upon research undertaken as part of this review. Note that individual projects may address more than one sector.

Fishing	• Changes in ecosystem composition and degradation, combined with pollution, will diminish fish catches • More conflicts between fishers and reduced income of fishers • Increased migration of young people unable to earn a living from fishing • Reduction of fish protein consumption	• Modify fishing methods and diversify fished species • Promote sustainable fish farming	10%
Forestry	• Increased tree mortality and decline in soil quality as conditions become drier, particularly in northern Senegal • Increased risk of bushfires • Loss of biodiversity	• Protect forests from bushfires and develop reforestation programs • Protect fauna and flora	5%
Social protection	• Greater exposure of populations in low-lying areas to coastal erosion and flooding	• Strengthen capacity to reduce, manage, and prevent disaster risks • Create information-dissemination systems resulting from early-alert systems • Establish agricultural insurance schemes	0%
Human health	• Increased morbidity and mortality from temperature-sensitive diseases such as cardiovascular diseases • Increased epidemics during flood episodes, such as of water-borne diseases like cholera • Increased incidence of vector-transmitted, climate-sensitive diseases, such as malaria and yellow fever	• Continue battle against malaria and other illnesses • Improve health insurance in high-risk sectors	0%
Housing	• Greater potential for loss and damage of homes due to flooding and sea level rise	• Improve living conditions • Support effective urbanization plans • Improve rainwater drainage	0%
Climate change knowledge		• Raise climate change awareness in all actors and incentivize research • Integrate climate risk management into local planning processes • Establish planning cells in each sectoral ministry to integrate climate risk management	25%

Particularly vulnerable regions	Particularly vulnerable groups	Status of climate governance (policies, institutions)
• Coastal zone, including coastal cities such as Dakar • Northern arid areas	• Women and youth • Artisanal fishers, small-scale farmers, and pastoralists	• National Climate Change Committee and Regional Climate Change Committees established • National Adaptation Programme of Action released in 2006 • Roadmap developed for preparation of National Adaptation Plan

Introduction

The West African country of Senegal lies along the North Atlantic Ocean, surrounding The Gambia and sharing borders with Mauritania, Mali, Guinea, and Guinea-Bissau. The country owes its name to the Senegal River that marks its eastern and northern borders. Aside from small relief in the southeast region, Senegal is a relatively low-lying country; about 90% of the country lies below 100 metres above sea level, and its highest elevation is just below 500 metres above sea level (Coulthard, 2001). While the country has experienced development gains in recent years, nearly 70% of Senegalese live in multi-dimensional poverty, and the country remains classified as a least developed country. The primary source of employment in rural areas is rain-fed agriculture, which is dominated by smallholders that often also engage in cattle raising. Fishing is also key to the overall economy. These characteristics leave the country vulnerable to climate change, which has the potential to derail its development path.

Senegal has experienced droughts on a recurrent basis since the 1960s, which has compromised food security and played a role in the migration of farmers to coastal cities, such as the capital city, Dakar (De Vit & Parry, 2011). These changes have been accompanied by other risks, such as floods, coastal erosion, and sea level rise. The latter affects many of Senegal's cities, including Dakar, as the vast majority of the population lives along the country's coast. The country's important tourism sector has also been adversely affected by, and has in part driven, the changes being experienced in its coastal zone. For these and other reasons, Senegal is considered to be among the countries most vulnerable to climate change (Schaeffer et al., 2015).

This paper provides a snapshot of Senegal's current and planned efforts to support adaptation to climate change. Drawing upon available literature, it has been prepared to support the work of the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA). Jointly funded by the UK Department for International Development (DFID) and the International Development Research Centre, CARIAA aims to help build the resilience of poor people to climate change in three hot spots in Africa and Asia: semi-arid areas, deltas in Africa and South Asia, and glacier- and snow-fed river basins in the Himalayas. To achieve this goal, it is supporting four consortia to conduct high-calibre research and policy engagement activities that will inform national and subnational planning processes in 17 countries, including Senegal.

The paper begins by providing a summary of current understanding of existing and projected climate risks in Senegal, followed by a discussion of the factors related to its current development status that increase the vulnerability of Senegal and its people to changing climatic conditions. Next, the potential implications of these changes for key sectors and groups are presented. An overview is then provided of the critical policies and plans shaping Senegal's efforts to address climate change adaptation at the national and subnational levels. To assess the extent to which efforts to address the country's critical

adaptation priorities are presently under way, section 5 paints a general picture of the scale, type, and focus of current and planned adaptation-focused programs and projects in Senegal, as well as the level of adaptation finance flowing into the country. A profile of the main networks and communities of practice active in the field of climate adaptation is provided in section 6. The paper concludes with an assessment of the general status of adaptation planning at the national and subnational levels in Senegal.

1. Current climate and projected changes

Senegal is generally characterized by a Sudano-Sahelian climate. It has two distinct seasons: a dry season that lasts from November to May and is influenced by the Harmattan and trade winds, and a wet season that occurs from June to October in the south and from July to September in the north, as the Inter-Tropical Convergence Zone moves northward (Ministère de l'Environnement et de la Protection de la Nature [MEPN, Ministry of Environment and Nature Protection], 2010; Noblet, 2013). The climate in West Africa, including Senegal, is characterized by high interannual and interdecadal variability (Daron, 2014). Rainfall varies along a latitudinal gradient that diminishes from the country's southern to northern regions to create four main rainfall zones: the Guinean and Sudano zones in the south, the central Sudano-Sahelian zone, and the Sahelian zone in the north with a desert climate (see Figure 1) (MEPN, 2010). Mean annual rainfall varies from 1,547 millimetres in the southern city of Ziguinchor to 330 millimetres in Podor, the northernmost town in Senegal (Coulthard, 2001).

Figure 1 – Climatic regions of Senegal (Le Fur, 2000)

Senegal's temperature gradient varies inversely with its precipitation pattern, with higher temperatures occurring in the north and lower temperatures in the south. Maximum temperatures are recorded during the beginning and end of the rainy season, reaching up to 40°C. Minimum temperatures are recorded during December and January (MEPN, 2010). Mean monthly temperatures along the country's coast, as recorded in Dakar, vary from a maximum of 24°C to 29°C to a minimum of 16°C to 23°C. Greater temperature variation is experienced in the country's interior, with temperatures in the northwestern town of Matam ranging from a maximum of 30°C to 41.5°C to a minimum of 12°C to 25°C (Coulthard, 2001). Between 1960 and 1990, Senegal's average annual temperature was 27.8°C (Butterfield, 2011).

1.1 Climate trends

The climate in Senegal has begun to change, with its mean annual temperature reported to have increased by 0.9°C since 1960, or an average rate of about 0.20°C per decade (McSweeney, New, & Lizcano, 2010). Warming has been greatest during the period of October to December, reported as rising by 0.29°C per decade between 1960 and 2006 (McSweeney et al., 2010). These findings are consistent with changes for West Africa as a whole, where average temperatures have increased by approximately 1°C over the past 50 years (Daron, 2014).

Detecting changes in rainfall patterns in West Africa is challenging given the region's natural variability on decadal and longer time scales, as well as existing limitations in data availability. Year to year rainfall variability is observed to be particularly variable in drier locations (Daron, 2014). Within this uncertainty, it appears that the timing of the rainy season in the coastal areas of West Africa between Liberia and Senegal has shifted, with decreased rainfall in the spring (March to May) and summer (June to August) (Daron, 2014). Rainfall variability is also noted by McSweeney et al. (2010), who describe a high rainfall period in the early 1960s and a dry period in the early 1980s. They also note that a statistically significant decrease in rainfall—of about 10 millimetres to 15 millimetres per decade—was observed during the wet season (July to September) in the southern regions of the country between 1960 and 2006 (McSweeney et al., 2010).

1.2 Climate change projections

Temperatures in West Africa, including Senegal, are projected to continue to rise over the remainder of this century. Under a high-emissions scenario, global climate models project that temperatures in West Africa could rise by a median value of 0.9°C (0.7°C to 1.5°C) by 2035, by 2.1°C (1.6°C to 3.3°C) by 2065, and by 4.0°C (2.6°C to 5.9°C) by 2100. Warming is projected to be greater than the median increase during the period of December to February and less than the median increase during the period of June to August (Christensen et al., 2013).[2] Similar results have been generated using a combination of two

[2] These projections represent a 50% likelihood of occurrence, using 39 global models and the Representative

global climate models and two regional climate models.[3] Under a high-emissions scenario, the model generating the greatest warming suggests that mean temperatures could increase by 3°C across the Sahel region by the 2040s. The more moderate models project that mean annual temperatures could rise by at least 1°C by the 2030s and at least 1.5°C by the 2040s (Daron, 2014).

Precipitation changes for West Africa are subject to substantial uncertainties. Model simulations of precipitation changes for the Sahelian and Sub-Saharan regions of Africa are divergent, with some studies showing evidence that the Sahel region will become drier during the second half of the 21st century and others projecting a wetter Sahel (Daron, 2014). This uncertainty range is reflected in the most recent analysis released by the Intergovernmental Panel on Climate Change (IPCC), which suggests that mean annual precipitation levels in West Africa could increase by 1% (uncertainty range of −4% to +8%) by 2035, 2% (−8% to +8%) by 2065, and 5% (−10% to +16%) by 2100. The increase in precipitation could be greater in the period of December to February compared to June to August (Christensen et al., 2013).[4] However, the same models project an average annual decrease of about 2% by 2100 for the Saharan region.

Other studies that have included regional models have produced divergent results, with some suggesting that the central regions of West Africa could receive up to 300 millimetres more rainfall annually by the 2040s, while others suggest modest increases or decreases in different locations or an overall drying trend (Daron, 2014). Other studies have suggested that there could be a delay in the onset of rainfall, greater rain in the latter part of the rainy season, longer dry spells, and possibly a reduction in the length of the rainy season. Overall it is expected that variability on interannual, decadal, and multi-decadal timescales will continue to be the dominate influence on rainfall levels and patterns in West Africa until about the end of this century (Daron, 2014).

For Senegal specifically, some model results project that mean annual temperatures could increase by 1.1°C to 3.1°C by the 2060s, and by 1.7°C to 4.9°C by the 2090s. The rate of warming is likely to be faster in Senegal's interior regions and marked by an increase in the frequency of hot days and nights compared to the current climate (McSweeney et al., 2010). With respect to changes in precipitation, analysis conducted by the Government of Senegal (GOS) suggests that the country could experience a decrease in precipitation and an increase in monsoon rains, with high interannual variability (MEPN, 2010).[5] The projections also suggest more frequent droughts and higher intensity of extreme rainfall events (due to higher humidity and temperatures), potentially leading to more floods (MEPN, 2010). The frequency of droughts is projected to increase dramatically in Senegal,

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Concentration Pathway 8.5 scenario for the time periods 2016–2035, 2046–2065, and 2081–2100, against a baseline period of 1986–2005.

[3] The global climate models were HADGem2 and ICHEC; the two regional climate models were KNMI and CCLM4 (Daron, 2015).

[4] These projections are based on 39 global models and the Representative Concentration Pathway 8.5 scenario for the time periods 2016–2035, 2046–2065, and 2081–2100, against a baseline period of 1986–2005.

[5] This analysis was based on the use of the regional climate model REgCM3 under scenario A1B (business as usual) (MEPN, 2010).

in particular in the north of the country, during the latter part of this century (2081 to 2100) (MEPN, 2010).

Lastly, a rise in sea levels of around 40 centimetres is projected to occur along Africa's Atlantic Ocean coastline shortly after 2050, which could put 0.5 million people at risk of flooding in Senegal (Schaeffer et al., 2015). By 2100, sea level rise along the Atlantic Ocean coastline could be around 80 centimetres above 2000 levels, should the world's mean annual temperature rise by over 4°C. Such a change would put even higher numbers of people at risk in the coastal cities of Senegal (Schaeffer et al., 2015).

2. Vulnerability to climate change

To set the stage for a discussion of Senegal's vulnerability to climate change and its adaptation needs, this section begins by providing an overview of the country's development context. This is followed by a summary of the potential impacts of climate change on Senegal's most vulnerable sectors, regions, and groups.

2.1 Current drivers of vulnerability

Senegal is classified among the least developed countries in the world, reflecting its low level of human development, the persistent poverty of much of its population, and its structural vulnerability to economic and environmental shocks. These factors, along with its changing population profile and continued dependence on climate-sensitive economic activities, increase Senegal's vulnerability to climate change. On the other hand, the country has one of the more stable governments in the region and has seen progress in some key development indicators. Table 1 presents basic statistics on Senegal's development characteristics.

Senegal has often been pointed to as a strong example of democratic government in Africa, since gaining independence in 1960. In recent years, though, the country has experienced unrest, initiated in 2011 with the movement "Y'en a marre" ("We've had enough") to protest against former president Abdoulaye Wade for presenting himself for a third term. Contentious elections held in 2012 led to the election of the current president, Macky Sall. The country is highly decentralized, having first initiated this process in 1872 (Nachmany et al., 2014). Important reforms took place in 1996 when state powers in nine areas—including land and urban planning, natural resource management, education and culture, health, and social development—were devolved to local governments. This meant that these local governments were granted responsibility for many sectors in which adaptation actions will be required. A third phase of reforms was launched in 2012, which aims to establish viable and competitive territories and give local governments greater responsibility for designing and implementing development efforts that reflect the interests

of communities. Objectives of the reformation process include building territorial coherence and creating development hubs, clarifying relationships between different levels of government, and improving fiscal mechanisms to promote regional development (Ministère de la Gouvernance locale, du Développement et de l'Aménagement du Territoire, n.d.; World Bank, 2015b).[6]

Development progress within Senegal remains low, with nearly 70% of Senegalese living in multi-dimensional poverty and its rural population remaining poorer than its urban population (UNDP, 2014b; World Bank, 2015a). However, the country has experienced some positive trends in its development progress. Life expectancy in Senegal is higher than for Sub-Saharan Africa as a whole, at 64.9 years for women and 61.9 years for men as of 2013. Access to improved sanitation has increased from 46.5% of the population in 2005 to 52% in 2012, despite a continually growing population. Similarly, rural access to improved water sources increased from 54% in 2005 to 60% in 2012 (World Bank, 2015a). In terms of health and well-being, infant mortality in Senegal has considerably decreased from 69.2 infants per 1,000 live births in 2000 to 43.9 infants in 2013, which is lower than the average for Sub-Saharan Africa of greater than 50 infants per 1,000 live births (United Nations Development Programme [UNDP], 2014b; World Bank, 2015a).

At the same time, the country's adult literacy rate remains low (52.1%), with literacy levels among women (59.0%) being lower than among men (74.0%) (UNDP, 2014a). Health expenditures also remain low as a share of GDP at 6%, compared to an average of 6.3% for Sub-Saharan Africa (UNDP, 2014a). Gender inequality in Senegal also remains high, with the country ranking 119 of 187 countries in 2013 on the Gender Inequality Index (UNDP, 2014a).

A further factor contributing to Senegal's vulnerability to climate change is the significant ongoing shift in its demographic profile. With an estimated population of 14.13 million as of 2013, its average annual population growth rate between 2010 and 2015 was 2.9%—slightly higher than Sub-Saharan Africa's average annual population growth rate of 2.7% (UNDP, 2014a). An outcome of this trend is that a large proportion of the population (42.5%) is under 14 years old and the median age of the population is 18.2 years (UNDP, 2014b; Central Intelligence Agency [CIA], 2015). This situation has significant implications for the country's need to create employment and opportunities for its youth.

Significant changes are occurring as well with respect to the location in which Senegalese live. While the majority of the population, about 57%, continues to live in rural areas, significant migration is taking place to Senegal's urban centres, particularly Dakar, where there is better infrastructure and access to health and other social services (Simonet &

[6] The Decentralization Act III passed in 2016 grants local authorities improved mechanisms for financing development initiatives, such as through taxation and innovative funding mechanisms (Diouf, n.d.). It also grants municipalities greater legal control over services such as natural resources management and disaster risk management (C. Simonet, personal communication, September 18, 2016).

Jobbins, 2015). Since 2010, the country's annual rate of urbanization has been about 3.6% (World Bank, 2015a; CIA, 2015). This process of urbanization was stimulated in part by recurring droughts in the 1970s and 1980s that contributed to a large migration of farmers toward the coastline. Today more than 80% of the population lives within a 200-kilometre-wide coastal band, with around 23% of Senegalese living in Dakar (MEPN, 2010). This has led to urban and land planning issues as well as increased pressure on the natural environment (Noblet, 2013). Consequently, the population is inequitably distributed within the territory; the highest population density is in the western region, and the lowest population density is in Tambacounda, in the eastern part of Senegal (MEPN, 2010). Additionally, Senegal has a net inward migration rate of 1.4 per 1,000 people (UNDP, 2014b).

The economy of Senegal remains largely dependent on climate-sensitive sectors, particularly agriculture, livestock, and fisheries. Agriculture continues to employ most of the rural population and a large share of the total labour force, although it represented only 15.6% of the country's GDP in 2014 (CIA, 2015). Agriculture is mostly rain-fed; in 2007, only 5% of agricultural land was irrigated. This makes the sector particularly vulnerable to the droughts that regularly occur in Senegal, as most of the country is located in the Sahel and Sahelo-Sudanese climatic zones (M. Ndiaye, 2007). Most farmers are smallholders who grow cash crops (e.g., groundnuts, peanuts, cotton, sugarcane) and subsistence crops (e.g., sorghum, millet, rice, corn, manioc), often while also raising cattle. Sorghum is mainly grown through recession agriculture in the vast alluvial plain of the Senegal River in the northern portion of the country (Mollard & Walter, 2008). Nuts and millet are cultivated throughout the centre and south of the country in the Sahelo-Sudanese climatic zone (MEPN, 2006).[7] Due to a change in precipitation and a water deficit, the nut-growing zone has been moving southward, toward the Kolda region (MEPN, 2010). Rice production occurs along the Senegal River Valley and in the Anambé Basin, horticulture production is found along the littoral zone of the coastline, and extensive livestock rearing and pastoralism is practised mostly in the north (Au-Sénégal.com, 2015; CIA, 2015; Food and Agriculture Organization [FAO], n.d.).

In 2010, fishing represented 32% of total exports and 2% of GDP, denoting the vital importance of this sector to the country's economy, in addition to being key for food security. Fishing is facilitated by Senegal's 700-kilometre-long coastline, favourable upwellings, and coastal population of around 6 million people (MEPN, 2010). It is mostly practised as artisanal fishing, although international fishing boats have been exerting significant pressure on fishing resources in recent years. This pressure is contributing to smaller-scale fishers adopting unsustainable practices, which further compromise this resource (Noblet, 2013).

Finally, a key export crop of Senegal is peanuts, and groundnut oil and the groundnut sector in general remain the principal source of income for rural areas. Other exports include

[7] In the Kaolack, Fatick, Diourbel, Thiès, and Louga Regions (MEPN, 2010).

fertilizer production, commercial fishing, phosphate, gold, and cement (CIA, 2015). While Senegal is exploring oil and iron ore exploitation, petroleum is one of the main products imported by the country (MEPN, 2010).

Table 1 – Key indicators of development progress for Senegal

Category	Indicator	Year	Value	Source
Human development	Human Development Index (score[d])	2013	0.485	UNDP (2014a)
	Human Development Index (rank[d] out of 187 countries)	2013	163	
	Population in multi-dimensional poverty (%)	2013	69.4	
	Under-five mortality rate (per 1,000 live births)	2013	60	
	Adult literacy rate (15 years of age and above) (%)	2013	49.7[c]	
	Improved water sources, rural (% of population with access)	2012	60	World Bank (2015a)
	Improved sanitation facilities (% of population with access)	2012	52	
	Access to electricity (% of population)	2010	56.5	
Gender	Gender Inequality Index (value[e] out of 187 countries)	2013	0.537	UNDP (2014a)
	Gender Inequality Index (rank[d] out of 187 countries)	2013	119	
Demographics	Total population (in millions)	2013	14.133[a]	UNDP (2014a)
	Average annual population growth rate (%)	2010	2.8	
	Population, urban (% of population)	2011	43.1[b]	
Economic development	GDP (in current USD, millions)	2013	14,791.69	World Bank (2015a)
	GDP growth (annual %) (average of 2010 to 2013)		3.2	
	Agricultural land (% of land area)	2012	46.8	
Governance	Corruption Perceptions Index (score[f] out of 174 countries)	2014	43	Transparency International (2014)
	Corruption Perceptions Index (rank[d] out of 174 countries)	2014	69	

	Fragile States Index (score)	2014	82.8	Fund for Peace (2014)
	Fragile States Index (status)	2014	Very high warning	
	Expenditure on education, public (% of GDP)	2012	5.6[c]	UNDP (2014a)
	Expenditure on health (% of GDP)	2011	6.0	
Environment	Population living on degraded land (%)	2010	16.2	UNDP (2014a)
	Change in forest area, 1990/2011 (%)	2013	–9.8	

[a] Projections based on medium-fertility variant
[b] Because data are based on national definitions of what constitutes a city or metropolitan area, cross-country comparison should be made with caution
[c] Data refer to the most recent year available during the period specified
[d] Where 1 or first is best
[e] Where 0 is best
[f] Where 0 is highly corrupt and 100 is very clean
[g] Where 120 is very high alert, and 0 is very sustainable

2.2 Vulnerability to climate change

With climate change projected to lead to higher temperatures, rising sea levels along its coastline, and uncertainty in terms of changes in rainfall patterns, it is not surprising that the Senegalese government has identified coastal zones, water resources, agriculture, fisheries, and health as key vulnerable sectors (MEPN, 2006, 2010). As noted in Table 2, Senegal is likely to be affected by coastal erosion, saline intrusion of groundwater and surface water sources, salinization of agricultural lands, decreasing soil fertility, loss of agricultural outputs, and reduced fish nursery habitats and stocks (MEPN, 2010).

Water resources are relatively abundant in Senegal, which has a potential of about 35 billion cubic metres per year. However, they are inequitably distributed, and surface water sources, such as the Senegal and Gambia Rivers, are very dependent on rainfall patterns (MEPN, 2006, 2010). While much uncertainty remains regarding future rainfall levels, it seems likely that water availability will diminish with climate change, especially groundwater. For example, northern groundwater table levels are expected to be reduced by 5 metres to 10 metres by 2100, according to simulations (MEPN, 2010). Historic events provide a window to the possible implications of climate change, should it lead to reduced water availability. Between 1970 and 1990, Senegal experienced a long period of rainfall reduction and, consequently, a serious drought in the Sahel. As previously noted, this situation led to a water deficit and the migration of people toward the coastline and Dakar. Water supply is now an issue in Dakar, as demand is constantly growing in the city (MEPN, 2006; Noblet, 2013). A similar pattern of enhanced migration due to growing aridity in the country's northern areas would put additional pressure on water and other resources in the country's coastal region.

Reduced groundwater and surface water availability is likely to also result from greater saline intrusion into rivers, aquifers, and soils, due to both sea level rise and rapid urban development along the coast. Reduced rainfall upstream, such as in times of drought, has also historically led to greater saline intrusion, which in turn resulted in the degradation of mangroves and negatively affected fishing in estuaries (MEPN, 2006).

Sea level rise will also lead to greater inundation of low-lying coastal areas, including those within urban centres. Floods are already a recurrent problem in all of Senegal's main cities during the rainy seasons (MEPN, 2006). These floods mostly affect poorer people who make their homes in informal urban settlements located in unsustainable and flood-prone zones. Current impacts include damage to infrastructure, temporary displacement of local populations, and blocking of access to certain regions (such as the Cap-Vert Peninsula). Health issues, such as cholera and malaria, due to stagnating waters and a deficient sanitation system, are also a concern (MEPN, 2006). Coastal erosion is already a problem; occurring at a rate of about 1 metres to 2 metres per year, it is causing damage to important infrastructure and the delocalization of people, as well as adversely affecting the tourism sector (MEPN, 2006).

The potential adverse consequences of sea level rise for Senegal have been demonstrated through a global study that estimated that 1,250 kilometres of the Senegalese coast needed to be protected from sea level rise. A second global study estimated that 7,450 square kilometres would be at risk by 2020, which would affect 3.7 million people. This study ranked Senegal as the eighth-most at-risk country in the world. A third study used four sea level rise scenarios for 2100, estimating that a 1-metre rise in sea level would lead to GDP losses of 12–17% and that 150,000 inhabitants (1.4–2.3% of population) would be at risk (MEPN, 2010).

Senegal's important agricultural sector will also be affected by expected changes in water availability, salinity rates, rainfall patterns, and temperatures. Over the past couple of decades this sector has been negatively affected by decreases in rainfall of around 35–45% in the country's northern areas, and decreases of around 20–25% in its southern areas. The country has also experienced a shortening and later onset of the rainy season (MEPN, 2010). With projected increases in temperature and uncertain rainfall patterns, Senegal is expected to experience further crop losses, as well as greater losses in cattle production through reduced availability of fodder and increased incidence of diseases. Moreover, Senegal is likely to continue to witness the southward migration of Sudanese and Guinean plant species due to increased aridity in the north.

Tourism has been considered a viable solution to reducing Senegal's vulnerability to climate shocks by helping to diversify its economy. However, due to the tourism industry's concentration along the coast and around urban centres such as Dakar and Saint-Louis, this sector is also vulnerable to the consequences of climate change. While the tourism industry has received significant support from international organizations, the effects of climate

change on Senegal's natural attractions, such as beach erosion, has already had a detrimental effect on the industry (Simonet & Jobbins, 2015).

Table 2 – Key vulnerable sectors in Senegal

Sector	Likely impacts of climate change
Water	• Climate hazards and changes in rainfall patterns influence and could reduce river runoff • Saline water intrusion—which is already a major issue, especially along the Casamance River—could lead to further vegetation and mangrove losses • A decrease in groundwater levels should there be a decline in rainfall and surface water availability, with implications for livestock and water usage in rural areas (via boreholes)
Agriculture	• Further soil degradation and loss of vegetation cover due to higher temperatures and decreased rainfall, leading to continued agricultural losses • Increased soil mineralization due to higher temperatures will also degrade soils and fertility • Greater saline intrusion due to sea level rise will lead to increased water and soil salinity, especially in rice cultivation zones in the Casamance region • Loss of fodder and diminished water availability will negative impact livestock and milk production • Increased pest and disease incidence is expected due to more floods, with implications for cattle production
Coastal zones	• Sea level rise will lead to greater flooding in low-lying coastal areas and infrastructure damage • Floods will continue to affect low-lying urban areas, particularly the poorer inhabitants in these locations, and populations and vegetation along rivers • Sea level rise will also increase saline intrusion of surface and groundwater bodies and soils, which will contribute to further degradation of mangroves • The tourism sector will be affected by infrastructure damage and the disappearance of sand beaches • Reduction in the availability of drinkable water
Health	• Increased morbidity and mortality from temperature-sensitive human diseases, such as cardiovascular diseases • Increased epidemics during flooding episodes, such as of water-borne diseases like cholera • Increased incidence of temperature-sensitive and vector-transmitted diseases such as malaria and yellow fever
Fishing	• Increased water temperatures will lead to changes in ecosystem composition and degradation that, combined with pollution, will influence fish distribution and fish reproduction zones; the outcome will be diminished fish catches, decreased consumption of fish proteins, and loss of income for fishers

	• More conflicts between fishers and increased migration of young people not being able to sustain themselves from fishing
Biodiversity	• Continued migration of plant species, with increased aridity and droughts in the north leading to expansion of Sahelian plants and the migration of Sudanese and Guinean plant species further south • Decrease in species diversity • Rising water temperatures will change species compositions and develop toxicities

Source: MEPN, 2006, 2010

Taking these expectations and the country's development status into consideration, Senegal has been ranked among the countries most vulnerable to and least ready to manage climate change risks and implement adaptation actions on the Notre Dame Global Adaptation Index (ND-GAIN). The ND-GAIN highlights Senegal's vulnerabilities due to its low agricultural capacity, propensity for low food security, relatively low access to reliable drinking water, limited dam capacity, and lack of medical staff. In terms of readiness, the ND-GAIN matrix found that Senegal lacks preparedness in terms of information and communications technology infrastructure and education. It also highlights the country's need for investment and innovation to improve its readiness (ND-GAIN, 2015b). Despite these challenges, as presented in Table 3, Senegal is generally considered to be less vulnerable and better able to respond to the risks posed by climate change when compared to other countries in West Africa.

Table 3 – Comparison of Global Adaptation Index scores for Senegal and neighbouring countries in 2013

Country	Vulnerability		Readiness		Overall
	World rank	Score*	World rank	Score**	World rank***
Senegal	142	0.499	133	0.359	138
The Gambia	163	0.550	138	0.350	153
Mali	174	0.588	135	0.354	161
Mauritania	163	0.550	159	0.313	163
Guinea	152	0.523	171	0.287	163
Guinea-Bissau	159	0.540	174	0.285	169
Ghana	126	0.440	90	0.465	102

* A lower score indicates lower vulnerability. The vulnerability score is determined based on indicators of exposure, sensitivity, and adaptive capacity, taking into consideration indicators related to six life-supporting sectors: food, water, health, ecosystem service, human habitat, and infrastructure.
** A higher score indicates a higher degree of preparedness. The readiness score takes into account measures of economic readiness, governance readiness, and social readiness to pursue adaptation actions.
*** Where a lower rank indicates lower vulnerability and a higher degree of preparedness.

Source: ND-GAIN, 2015a

3. Adaptation planning context

To assess the extent to which adaptation planning is occurring in Senegal, this section provides an overview of the key policies and plans shaping the direction of development and climate action in Senegal. This includes national development policies and plans that establish the broad vision and goals of the country, as well as climate change plans and strategies, including those specifically addressing adaptation. The extent to which current strategies and plans of relevance to particularly vulnerable sectors have begun to integrate climate changes is also discussed. Table 4 provides a summary assessment of Senegal's progress in establishing a climate governance framework.

Table 4 – National adaptation planning context: Summary of progress as of September 2015	
Indicator	**Progress**
Climate change recognized in Senegal's guiding development vision/plan	Yes, partly, in the National Strategy for Economic and Social Development (2013–2017) (SNDES)[8] and the Emerging Senegal Plan (2014–2035) (PSE)[9]
National-level coordinating entity for climate change established and active	Yes, the National Climate Change Committee has been established, along with Regional Climate Change Committees
Climate change policy and/or law in place	Not present
Climate change strategy published	The National Strategy to Implement the United Nations Framework Convention on Climate Change (UNFCCC) (SNMO)[10] was prepared in 1999; a more recent strategy has not been prepared
Climate change action plan published	Not present
Adaptation plan published	A National Adaptation Programme of Action was published in 2006, and a process for developing a National Adaptation Plan has been initiated
Climate change fund or adaptation fund operational	Yes, a national climate fund was created in 2015
Climate change units established in key ministries	Not present
Climate change integrated into national sectoral policies	In some, such as water and fishing policies

3.1 National-level development policy context

National development planning in Senegal is primarily shaped by two current policies: the Emerging Senegal Plan (PSE)[11] adopted by the government in 2012, and the National Strategy for Economic and Social Development 2013–2017 (SNDES).[12] The need to adapt to the impacts of climate change is acknowledged to some extent in both of these documents.

The PSE sets out Senegal's medium- and long-term social and economic development vision. Its goal is to see Senegal embark on a new trajectory that will enable the country to achieve social solidarity and rule of law by 2035. The strategy is oriented around three strategic pillars:

[8] *Stratégie Nationale de Développement Economique et Sociale.*
[9] *Plan Sénégal Émergent.*
[10] *Stratégie Nationale Initiale de Mise en Œuvre de la Convention Cadre des Nations Unies sur les Changements Climatiques*.
[11] *Plan Sénégal Émergent.*
[12] *Stratégie Nationale de Développement Economique et Sociale.*

1) Structural transformation of the economy, under which efforts will be made to promote continued growth and development, create wealth and jobs, ensure social inclusion, and give attention to development needs in all regions of the country.

2) Human capital, social protection, and sustainable development, under which priority will be given to promoting well-being, social equality, and preservation of the country's natural resource base.

3) Governance, institutions, peace, and security, with a focus on stability, protecting rights, and ensuring the rule of law.

The strategy references the risk that climate change poses, particularly with respect to the country's coastal areas. It also notes the importance of promoting a culture of disaster risk reduction and prevention through improved management of natural disaster assistance and insurance mechanisms, emergency funding, and capacity building. The action plan component of the strategy makes a specific financial commitment of 36.4 billion XOF (approximately CA$79.9 million) to fund environmental projects, including specific adaptation projects (GOS, 2014).

The PSE complements the SNDES, which is the result of a policy update of the Economic and Social Political Document (2011–2015),[13] made to reflect changing national conditions following the 2012 national elections. Overall, it aims to increase economic and social growth while adopting a sustainable development approach. It also aims to facilitate intra- and inter-generational solidarity and achievement of Senegal's Millennium Development Goals (MDGs). To reach its objectives, the strategy is built around the same three pillars as those contained in the PSE. It recognizes climate change adaptation as one of the new challenges that the country faces, along with energy efficiency, food security, and peace and security. Adaptation is indirectly targeted under the strategy's second strategic objective focused on sustainable development. It refers to reducing the negative impacts of climate change on ecosystems, as well as the prevention and management of risks and disasters. However, this is not stated as a priority action in the document. In fact, while formulating national policies promoting resilience to climate change is cited, this is recognized as a minor priority.

3.2 National-level climate policy context

Senegal has been actively engaged on the issue of climate change for a number of years, elaborating its National Strategy to Implement the United Nations Framework Convention on Climate Change (UNFCCC) (SNMO)[14] in 1999 (GOS, 1999). The GOS released its First National Communication to the UNFCCC in 1997 and its Second National Communication in

[13] *Document de Politique Économique et Sociale 2011–2015.*
[14] *Stratégie Nationale Initiale de Mise en Œuvre de la Convention Cadre des Nations Unies sur les Changements Climatiques.*

2010.[15] In its efforts, Senegal has approached climate change issues through a development focus (Nachmany et al., 2014; Sall, Tall, Tandian, & Samb, 2011).

The SNMO was a pioneering policy instrument that formed an important foundation for Senegal's efforts to integrate climate change, including adaptation, into its economic and social development policies and programs (Noblet, 2013; Sall et al., 2011). It describes the country's national context, provides its first greenhouse gas inventory, explores the vulnerability of the country's main sectors, and identifies how to best integrate climate change into future development efforts. The strategy was aligned with the development priorities identified in Senegal's Ninth Economic and Social Development Plan,[16] and emphasizes a commitment to addressing climate change while achieving its development goals.

In 2006, Senegal submitted its National Adaptation Programme of Action (NAPA) to the UNFCCC. The NAPA identifies water resources, agriculture, and coastal zones as the country's most vulnerable sectors. Priority adaptation measures for each of these sectors are identified. In the water sector, the GOS notes the need to revitalize river systems and protect available water resources from, for example, pollution and over-extraction. Priorities for the agriculture sector include continuing existing drought and desertification management efforts; promoting sustainable land management practices (e.g., agroforestry, crop diversification, community forests, the establishment of early-warning systems); and undertaking research in areas such as improved water use in agriculture. For the country's coastal areas, capacity building, technology, natural resource management, legal, and institutional options for reducing vulnerability are identified. Areas of Senegal identified as being particularly vulnerable to climate change include the northern zone, consisting of river valley and silvo-pastoral agriculture systems; the highly populated areas in the Niayes zone and peanut-growing zones; and, in southern Senegal, the Tambacounda and the Upper, Lower, and Middle Casamance regions with mangroves, vulnerable soils, and poor water infrastructure. Women and youth are considered to be particularly vulnerable groups and of high priority for support through adaptation projects.

Water resources, agriculture, and coastal zones are also identified as priority areas for adaptation in Senegal's Second National Communication released in 2010. It presents adaptation needs along three pillars:

1) Developing knowledge regarding climate change impacts and transferring appropriate technologies.

2) Strengthening actions that prevent and reduce the impact of climate change on vulnerable sectors, particularly social protection, housing, and human health.

[15] Senegal's Third National Communication to the UNFCCC was released in 2016.
[16] *Le Neuvième Plan de Développement Économique et Social*.

3) Promoting the sustainable management of natural resources, including freshwater, agricultural, coastal zone, fisheries, and forestry resources.

A synopsis of the adaptation actions identified in Senegal's NAPA and Second National Communication is provided in Table 5.

In July 2015, Senegal officially launched its National Adaptation Plan (NAP) process, with financial support from the Governments of France and the United Kingdom. A NAP training and consultation workshop took place, at which various government departments discussed the relevance of the NAP process for Senegal and entry points in existing policy processes (UNDP, n.d.-b). The Ministère de l'Environnement et du Développement Durable (MEDD, Ministry of Environment and Sustainable Development) has developed a roadmap for the NAP process that aims to identify opportunities and channels for regional and national cooperation, as well as financial and budget planning (G.P. Ndiaye, 2014).

The GOS also signalled its adaptation priorities and plans in its Intended Nationally Determined Contribution (INDC)[17] released in September 2015. In this document, the GOS indicates an intention to treat climate change as a national priority when developing future policies and plans. Priority areas for action are identified as being those that directly relate to strengthening the national economy, namely agriculture, fisheries, tourism, health care, nutrition, and water. The GOS also states that it intends to integrate adaptation into sectoral policies. The INDC identifies specific adaptation objectives between 2016 and 2035 in relation to eight sectors: biodiversity, coastal zones, water resources, fisheries, agriculture, livestock, flooding, and health. The total budget for adaptation actions identified in the INDC is estimated at US$14.558 billion. Of this, US$1.832 billion is estimated to come from national funds and US$12.726 billion from foreign financing (MEDD, 2015).

Senegal's INDC also discusses the principal obstacles and factors for success in implementing its intended adaptation measures. The obstacles focus on the country's ability to conduct adaptation planning at a national level, the need to simplify current legislation for easier implementation, the development of a multisectoral approach that impacts key sectors of the economy, and the need to develop an effective communication strategy so that political figures and the public are aware of the risks of climate change. Factors for success identified relate to the presence of supporting institutions, such as a national committee on climate change; efforts to integrate adaptation to climate change into various sectoral policies; and the presence of supporting policies, such as the National Biodiversity Strategy and Action Plan[18] (MEDD, 2015). Future implementation of the commitments contained in the INDC will depend on government leadership to provide and secure required financial support.

In addition to these climate change–focused initiatives, Senegal is also a part of the Global Alliance for Resilience, an initiative of the Food Crisis Prevention Network. Launched in

[17] *La Contribution Prévue Déterminée au niveau National*.
[18] *La Stratégie et le Plan National d'Actions pour la Conservation de la Biodiversité*.

2012, this regional platform brings together 17 Sahelian and West African countries with the aim of eradicating hunger and malnutrition over the next 20 years. It is supporting efforts to improve preparation for and responses to food crises in the region and build the resilience of vulnerable households and communities. As part of this network, Senegal has identified national resilience priorities that are in the process of being validated. The Alliance is supported technically and politically by the Economic Community of West African States, the West African Economic and Monetary Union, and the Permanent Interstate Committee for Drought Control in the Sahel (OECD, n.d.).

As previously noted, Senegal engaged in a decentralization process that has allocated powers related to land and urban planning, natural resource management, education and culture, health, and social development to local governance institutions. To date, though, integration of climate change issues into regional- and local-level development planning has been weak (Sall et al., 2011). Some efforts are under way in the country to strengthen the capacity of local governments to take on this responsibility. Among these is an initiative led by the Near East Foundation; Innovation, Environnement, Développement en Afrique (Innovation, Environment, Development in Africa); and the International Institute for Environment and Development to establish local climate funds in four departments. Capacity is being built to enable local governments to identify and finance their adaptation priorities (Near East Foundation, 2015).

Table 5 – Priority adaptation actions by sector identified in Senegal's NAPA and Second National Communication

Sector	Adaptation priorities
Water resources	• Establish infrastructure to decrease water loss into the sea • Enforce strict control of chemical use (e.g., pesticides, fertilizers) • Maintain a balance between the exploitation and renewal of water stocks • Ensure early treatment of polluted water and establish water purification systems • Improve education and raise awareness • Introduce rainwater harvesting • Engage in sea water desalinization
Agriculture	• Develop agroforestry practices and expand community forests • Diversify crops and promote the growth of crops tolerant to extreme climatic conditions • Improve management and reuse of water • Develop rationalized fertilization practices • Reorganize livestock breeding • Establish early-alert systems in rural areas • Undertake research on desertification
Coastal zones	• Establish a strict definition of the coastal development zone and an institutional structure responsible for coastal zone management

	• Strengthen land planning in coastal towns • Increase information dissemination • Establish protections for different ecosystems and species
Fishing	• Modify fishing methods • Diversify fished species • Promote sustainable fish farming
Forestry	• Protect forests from bushfires and protect fauna and flora • Develop reforestation programs
Social protection	• Strengthen capacities to manage disaster risk reduction and prevention activities • Create systems to disseminate information resulting from early-alert systems • Establish agricultural insurance schemes
Human health	• Continue the battle against malaria and other illnesses • Improve health insurance in high-risk areas
Housing	• Improve living conditions • Support effective urbanization plans • Improve rainwater drainage systems
Climate change knowledge and technology transfer	• Raise climate change awareness among all stakeholders • Integrate climate risk management within local planning processes • Establish planning cells among sectoral ministries to promote cross-ministerial integration of climate risk management • Incentivize research • Establish and promote financial resources for technology transfer • Build capacity regarding adaptation technologies and harness local knowledge

Source: De Vit & Parry, 2011; MEPN, 2006, 2010

3.3 Institutional structure for climate governance

The MEPN, now the MEDD, led development of Senegal's SNMO, NAPA, and National Communications. The MEDD and its Environment Directorate[19] are in charge of implementing the GOS's policies on the environment. In addition, Senegal established its National Climate Change Committee (COMNACC)[20] in 2011, which became a central platform for inter-ministerial cooperation on climate change (Nachmany et al., 2014). The COMNACC is the formal link between global and national climate politics and plays a key role in overseeing all activities related to the UNFCCC. It also plays a key role in disseminating climate information and assisting with the development of national and subnational climate change projects. Several bodies of executive power, NGOs, academia

[19] Direction de l'Environnement et des Etablissements classés.
[20] Comité national sur les Changements climatiques. The Committee was created in 1994 but could not be officially institutionalized before 2003 (Ministerial Decree n 1220) and was finally made functional in 2011 (Ministerial Decree 2011-1689).

(research institutes and universities), and civil society organizations are members of the COMNACC, which is headed by a president and vice-president nominated by the MEDD (Nachmany et al., 2014). The Environment Directorate acts as secretariat for the COMNACC.

Regional Climate Change Committees (COMRECCs)[21] were also established as part of the same ministerial decree that created the COMNACC. Their aim is to promote synergies between the local and national levels, with the COMNACC active in managing and facilitating decentralized governance on climate change issues (MEPN, 2012). However, these have only recently become active due to a lack of financial resources and climate knowledge. Through international development cooperation support, the institutional capacities of COMRECCs and knowledge on climate change has been increased (UNDP, n.d.-a).

Finally, in 2015, the MEDD announced the establishment of the National Climate Fund[22] ("Fonds national climat," 2015; "Environnement—le Sénégal met en place," 2015). The objective of the fund is to mobilize US$60 million per year to finance climate projects and sustainable development, taking advantage of international sources of climate finance such as the Green Climate Fund. It is expected that the GOS will mobilize US$10 million per year for the fund and that the rest will come from development partners such as the UNDP and the Senegalese Ecological Monitoring Centre. The UNDP will manage the fund temporarily. There also are plans to establish a national steering committee, chaired by the Ministère de l'Economie, des Finances et du Plan (Ministry of Economy, Finances and Planning), and a national strategic orientation body, chaired by the MEDD ("Environnement—le Sénégal met en place," 2015). Dispositions are planned to ensure independent evaluation of the national climate fund's performance.

Entities within Senegal are also striving to be accredited to enable them to directly access international climate funds. The Senegalese Ecological Monitoring Centre was accredited as a national implementing entity by the Adaptation Fund Board in 2010 and was accredited to the Green Climate Fund in March 2015 (UNFCCC, 2015).

3.4 National-level sectoral policies

While Senegal has identified the need to integrate climate change considerations into sectoral policies and plans, progress toward this goal has been very limited so far. As indicated in Table 6, of the policy documents reviewed as part of this study, only water-related sectoral policies, including for fishing, recognize climate change as a risk. The attention given to climate change impacts within these sectors perhaps reflects the fact that Senegal has been experiencing significant coastal erosion and flooding in its major cities.

While climate change is not mentioned in the Water and Sanitation in Urban and Rural Settings Policy Letter from 2005,[23] it is recognized as one of the major problems facing the

[21] Comités régionaux sur les Changements climatiques.
[22] Fonds National Climat.
[23] *Lettre de politique sectorielle de l'hydraulique et de l'assainissement en milieu urbain et rural*.

water sector in Senegal's Integrated Water Resource Management Action Plan 2008–2015 (PAGIRE),[24] released in 2007. The plan also highlights constraints such as a lack of human and financial capacities and the lack of a favourable institutional framework to enable participation by all stakeholders (Ministère de l'Hydraulique, 2007). The objective of the Action Plan is to implement integrated water resource management in a manner that is adapted to the national context and aligned with national goals related to poverty reduction and the MDGs. Its three strategic axes include:

1) Improving knowledge and capacities to manage water resources
2) Creating a favourable environment for integrated water resource management through legal and political reforms
3) Improving communication and information, and raising awareness on water use

Assessing climate change impacts on water resources and developing strategies to reduce these impacts are considered to be one of the measures needed under the first strategic axis to improve the performance of water protection and management systems. Moreover, the development and implementation of climate adaptation actions to reduce impacts on water resources and water users is one of the priority activities considered in the implementation of the PAGIRE during its first years of implementation. The needed budget for this activity has also been evaluated, but no specific adaptation measures are described.

Activities within Senegal's fisheries sector are framed by the Sustainable Development Strategy for Fishing and Aquaculture[25] published in 2001, the Sectoral Policy Letter on Fishing and Aquaculture from 2007,[26] the PAGIRE from 2007, and the Maritime Fishing Code[27] of 2015. The 2001 Sustainable Development Strategy identifies climate change as a potential threat to inland freshwater fishing, noting that past rainfall deficits and disruption of the hydrological regime by infrastructure such as dams has driven fishers to become agricultural labourers. However, not much emphasis is placed on climate change elsewhere in the document, and no strategy or action targeting this risk is identified (Ministère de la Pêche et des Transports Maritimes, 2001). In contrast, the Sectoral Policy Letter of 2007 does not identify climate change as a risk to the sector (Ministère de l'Economie maritime, des Transports maritimes, de la Pêche et de la Pisciculture, 2007).

Regarding the livestock, agriculture, pastoralism, and forestry sectors, the GOS passed an Orientation Law on Agriculture, Forestry, and Pastoralism in 2004,[28] which provides a 20-year vision for the development of these sectors and replaces all previous sectoral policies (Bureau d'analyses macro-économiques, n.d.). It is also the foundation on which key

[24] *Plan d'Action de Gestion Intégrée des Ressources en Eau*.

[25] *Stratégie de développement durable de la pêche et de l'aquaculture*.
[26] *Lettre de Politique Sectorielle des Pêches et de l'Aquaculture*.
[27] *Le Code de la Pêche Maritime*.
[28] *Loi d'Orientation Agro-Sylvo-Pastorale*, Loi n° 2004-16 du 4 juin 2004.

programs of relevance to each sector have been elaborated, such as the National Agricultural Development Programme,[29] the Forestry Action Plan,[30] and the National Livestock Development Plan.[31] The first specific objective of the development policy is to reduce the impacts of climatic, economic, environmental, and sanitary risks, but specific measures for achieving this goal are not elaborated.

Agriculture policy in Senegal is also informed by the Return to Agriculture Plan (2006),[32] which aims to help operationalize the country's SNDES and the agricultural component of the Orientation Law. The Plan aims to reduce food insecurity, increase productivity, and expand the range of people involved in agriculture (particularly women, youth, migrants, and returnees). Climate change is not mentioned as a risk to the achievement of its objectives (Ministère de l'Agriculture, de l'Hydraulique Rurale et de la Sécurité Alimentaire, 2006).

The Strategic Plan for Sustainable Tourism Development in Senegal (2014–2018)[33] aims to increase the number of tourists to the country from nearly 1 million in 2011 to 2 million in 2018. Among the strategies for achieving this objective, the Plan includes the development of ecotourism opportunities (Ministère du Tourisme et des Transports Aériens, 2013). The plan does not identify climate change as a potential risk, even though coastal erosion is mentioned as an issue of concern.

Senegal has established a national framework for advancing disaster risk management under the leadership of the Civil Protection Directorate,[34] which acts as Senegal's focal point on disaster risk reduction national and internationally. Senegal has also established a high-level Civil Protection Commission,[35] associated regional and auxiliary commissions, a national platform for disaster risk prevention and reduction, and national and regional risk reduction and prevention plans. The government has also been pushing for the integration of disaster risk management in national and sectoral strategies, as reflected in the content of the PSE. It has also developed a National Programme for Disaster Risk Reduction[36] with the UNDP's support, which further aims to integrate disaster risk reduction into social and economic policies (Ministère de l'Intérieur et de la Sécurité Publique, n.d.; "Réduire les risques," 2014). To address the specific risk posed by flooding, the government has prepared a 10-year Flood Management Program (2012–2022).[37] It highlights the need to prevent and manage floods as a national priority within national disaster risk reduction strategies (Diop, 2014).

[29] *Programme National de Développement Agricole*.
[30] *Plan d'Action Forestier du Sénégal*.
[31] *Plan National de Développement de l'Elevage*.
[32] *Plan Retour Vers l'Agriculture (R E V A)*.
[33] *Plan Stratégique de Développement Durable du Tourisme au Sénégal (2014–2018).*
[34] La Direction de la Protection Civile.
[35] *La Commission Supérieure de la Protection Civile*.
[36] *Programme National de Prévention, de Réduction des Risques Majeurs et de Gestion des Catastrophes Naturelles*.
[37] *Le Programme décennal de Gestion des Inondations 2012–2022*.

In regard to gender policies, Senegal has promoted the integration of gender equality into national policies such as the SNDES and elaborated specific strategies such as the National Strategy for Equity and Equality of Genders 2005–2015, [38] adopted in 2008 and currently under review (Ngaïdé & Chambaz, 2007; Ba, 2015). Climate change issues do not appear to be integrated into this strategy.

The National Development Plan for the Health Sector 2009–2018[39] is the reference document for all stakeholders in the health sector. It aims to accelerate modernization of health services, reduce chronic diseases, and reduce maternal morbidity, among other goals. Climate change is not identified as a risk to be considered by the health care sector.

Table 1 – Integration of climate change into national sectoral strategies, polices, and plans: An assessment of progress

Policies	Absent	Climate change mentioned as potential risk	Possible actions for reducing risk identified	Targets identified for specific adaptation measures
Action Plan for Integrated Water Resource Management (2008–2015)		✓		
Sustainable Development Strategy for Fishing and Aquaculture (2001)		✓		
Orientation Law on Agriculture, Forestry, and Pastoralism (2004)	✓			
Strategic Plan for Sustainable Tourism Development in Senegal (2014–2018)	✓			
National Strategy for Equity and Equality of Genders (2005–2015)	✓			
National Development Plan for the Health Sector (2009–2018)	✓			

[38] *Stratégie Nationale d'Equité et d'Egalité de Genre*.
[39] *Plan National de Développement Sanitaire 2009–2018*.

4. Current and planned adaptation programs and projects

A range of projects and programs must be implemented to support Senegal's efforts to reduce its vulnerability to the impacts of climate change. To better understand the scope of current efforts to build Senegal's adaptive capacity, this section provides an overview of current and recently completed discrete adaptation projects and programs implemented in the country. A brief analysis of the scale of climate finance flowing into Senegal from international sources is also provided.

4.1 Adaptation projects and programs

Ongoing, recently completed, and planned adaptation programs and projects being implemented in Senegal were identified through a review of online sources, including the websites of UN agencies, multilateral development banks, bilateral development agencies, and research and international NGOs. The research focused on projects and programs that aim to support climate change adaptation, as reflected in their title, goals statement, and/or objectives statement. All relevant projects and programs were captured in a database and classified according to their type and areas of focus. A detailed description of the methodology used in the review is provided in Annex A.

The review found 20 significant adaptation projects financed at least in part by international donors. A snapshot of key facts around these projects is presented in Table 7, and further details are presented in Annex B. It is recognized that this review does not capture all of the projects and initiatives being implemented in Senegal that are helping to build its adaptive capacity and reduce its vulnerability to climate change; rather it only captures discrete adaptation-focused projects in accordance with the selection criteria described in the methodology.

Table 7 – Sectors of focus of current adaptation projects and programs identified in Senegal

Sector of focus	Priority sectors for adaptation	Number of projects*	Percentage of total projects**	Geographical characteristics	
Agriculture	✓	6	30%	National projects	10
Pastoralism	✓	2	10%	Regional projects	8
Forestry	✓	1	5%	Global projects	2
Ecosystem conservation		4	20%	Total	20

Ecosystem restoration		1	5%
Watershed management	✓	1	5%
Freshwater supply	✓	1	5%
Coastal zone management	✓	2	10%
Marine fisheries	✓	2	10%
Disaster risk management	✓	5	25%
Private sector		1	5%
Insurance		2	10%
Waste management	✓	1	5%
Peri-urban areas		1	5%
Urban areas		2	10%
Climate information	✓	5	25%
Government	✓	6	30%
Civil society		1	5%
Multisectoral		2	10%
Other		2	10%

*Individual projects may address one or more sectors.
**Calculated by the number of projects active in this sector relative to the total number of projects identified, reflecting the potential for a single project to address adaptation needs in more than one sector.

Of the adaptation projects currently being implemented in Senegal, the greatest number focus on agriculture and water resources. An emphasis on adaptation in these sectors is not surprising given that they were identified as priority areas for action in Senegal's NAPA and Second National Communication. Projects with a strong focus on water resources often address the growing risk of flooding in urban and peri-urban areas, as well as reducing coastal erosion and saline intrusion through improved physical and natural infrastructure (e.g., mangroves). In general, most projects include a disaster risk reduction component, especially related to flood risks. For example, the project Integrated Management of Senegal's Coastal Areas: In-depth assessments and concrete measures for responding and adapting to climate change includes efforts to create early-warning systems, restore ecosystems, and build a drainage canal to reduce erosion and flooding. The Disaster Risk Management and Climate Change Adaptation project focuses specifically on mainstreaming disaster risk management and climate change adaptation, and on strengthening relevant institutions such as the Civil Protection Directorate.

The agricultural sector is the focus of the largest number of projects identified, reflecting its importance to local livelihoods and the national economy. Several of these projects focus on the needs of agro-pastoralists, such as the Strengthening the Resilience of Pastoralists and Agro-pastoralists through Trans-border Livestock Mobility project funded by the DFID, the European Union, and Acting for Life. Similarly, the project Mainstreaming Ecosystem-based Approaches to Climate-resilient Rural Livelihoods in Vulnerable Rural Areas through the Farmer Field School Methodology, funded in part by the Least Developed Countries Fund (LDCF), aims to enhance the capacity of agro-pastoralists to adopt more climate-resilient production systems and to mainstream climate change adaptation into agro-pastoral and agricultural development policies and programs. A project with a strong focus on involving the private sector, the R4 Rural Resilience Initiative, has a focus on increasing food security through mechanisms such as insurance and increasing access to microcredit.

Additionally, Senegal initiated and is part of the Great Green Wall for the Sahara and Sahel Regional Initiative, which aims to strengthen the resilience of people and natural systems living in arid areas through sound ecosystems management and sustainable development of land resources. It is worthwhile to highlight that Senegal has long been involved in the fight against desertification and is a participating member of the Permanent Interstate Committee for Drought Control in the Sahel. The country's involvement in these initiatives reflects its historical concerns related to drought management and the strong attention given by the government to ensuring the food security of its people.

While fishing is a key sector for the country's economy and has been recognized as a priority sector by the GOS, only a few projects directly focus on its needs. Among these is the Support for Sustainable Climate Change Adaptation in Marine Artisanal Fisheries Communities in West Africa project, which aims to build the capacity of selected artisanal fisheries communities to adapt to climate change by strengthening local value chains. As the identified projects focus on coastal fisheries, it appears that limited attention is being given to meeting the needs of the inland fisheries sector, although Senegal has two main rivers where fishing takes place.

Several projects focus on strengthening access to climate information and building the capacity of government to mainstream climate issues into decision-making. This includes Senegal's participation in a project being implemented as part of the Climate Change, Adaptation and Food Security (CCAFS) program, Capacitating African Smallholders with Climate Advisories and Insurance Development. The project is providing smallholder farmers in West Africa with access to climate information and supporting the development of index-based insurance. One of its activities in Senegal is to upscale access to seasonal forecasts though rural radio networks (CCAFS, n.d.). Senegal is also engaged in the Climate for Development in Africa project, which aims to make available and strengthen the use of climate information. As well, the Global Climate Change Alliance's Regional Program for West Africa sought to build the capacity of national and regional stakeholders to understand climate science and mainstream climate change considerations into development policies.

Some projects also support the production of climate forecasts, the installation of meteorological stations, and the development of early-warning systems. This includes the project led by the UNDP and the MEDD called Strengthening Land and Ecosystem Management Under Conditions of Climate Change in the Niayes and Casamance Regions as well as the Disaster Risk Management and Climate Change Adaptation project.

Interestingly, many of the adaptation projects being implemented in Senegal use an ecosystem-based adaptation approach, building natural barriers to reduce disaster risks. This includes the Ecosystems Protecting Infrastructure and Communities project, which aims to harness ecosystem services to protect vulnerable communities from climate change risks. As well, the Integrated Management of Senegal's Coastal Areas project includes measures to restore mangrove plantations to create a natural barrier to coastal erosion. An ecosystem-based approach to adaptation fits well with the integrated water management approach being promoted in Senegal.

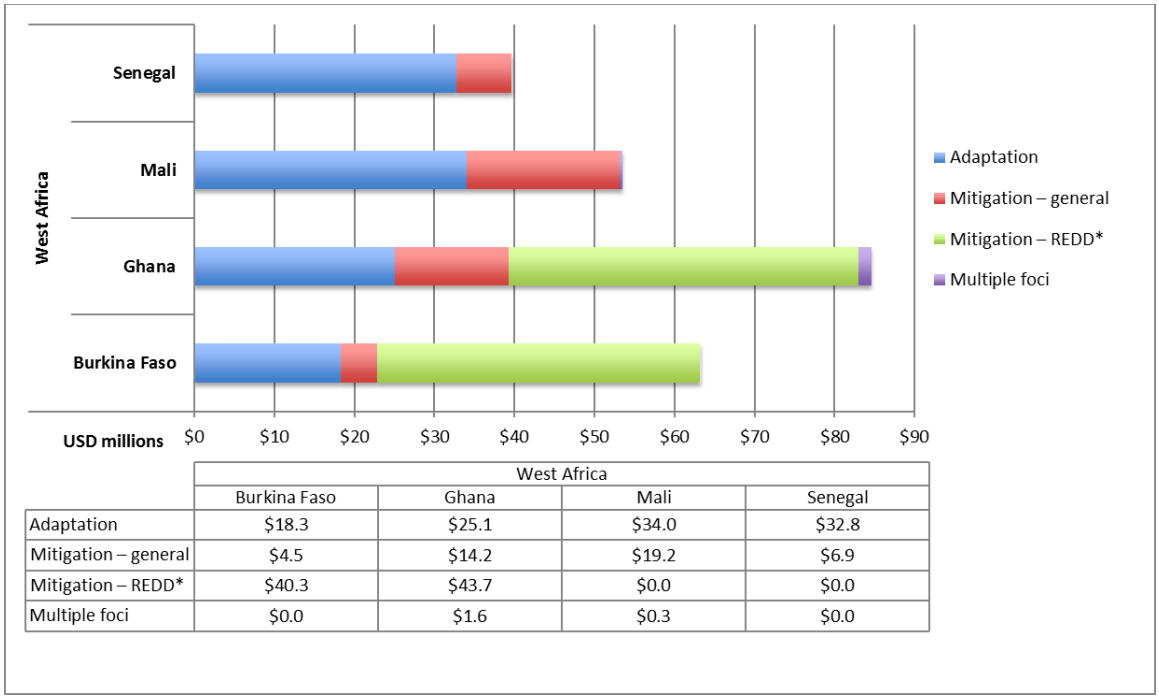
A few gaps in adaptation programming may be observed based on this review. Even though forests and human health were identified as priority sectors, few projects were found that specifically target these areas. And while a few projects include a designated gender component, projects specifically designed to address the needs of women were not identified.

4.2 Climate finance

This section provides an overview of the scale, sources, and orientation of current climate finance flowing into the country. While recognizing that the GOS supports adaptation efforts through its national budget, either intentionally, as through its financing of the national climate fund, or indirectly, as through its support for actions that build adaptive capacity, the aim of this section is to profile the support Senegal receives from international multilateral and bilateral sources.

Senegal has benefited from a number of targeted resources for climate change adaptation. According to the Climate Funds Update (2015), which tracks climate financing through designated bilateral and multilateral climate funds, Senegal received a total of US$39.7 million in climate financing between 2003 and April 2015 to support nine projects. The majority of this funding, over 82%, has been directed toward five adaptation projects financed by the Adaptation Fund, the LDCF, the Global Environment Facility, the Global Climate Change Alliance, and the MDG Achievement Fund. The focus of these projects included adaptation to coastal erosion in vulnerable areas, watershed management and water retention, and mainstreaming ecosystem-based approaches to climate-resilient rural livelihoods in vulnerable rural areas.

As illustrated in Figure 2, Senegal received less financing from designated climate change funds than its West African country neighbours. However, strictly looking at funds designated toward adaptation, Senegal and Mali have each registered significant pledges.



	West Africa			
	Burkina Faso	Ghana	Mali	Senegal
Adaptation	$18.3	$25.1	$34.0	$32.8
Mitigation – general	$4.5	$14.2	$19.2	$6.9
Mitigation – REDD*	$40.3	$43.7	$0.0	$0.0
Multiple foci	$0.0	$1.6	$0.3	$0.0

*Reducing emissions from deforestation and forest degradation

Figure 2 – Comparison of approved funding from designated bilateral and multilateral climate funds in West Africa from 2003 to April 30, 2015, in USD millions (based on Climate Funds Update, 2015)

An analysis of the Organisation for Economic Co-operation and Development (OECD) Rio Markers, which reports on climate-related official development assistance from multilateral and bilateral sources, discloses that Senegal received US$188.8 million in funding from bilateral donors between 2010 and 2013 for projects that had a principal or significant focus on climate change adaptation. Primary bilateral funders for climate adaptation included France, Germany, and Japan, as well as EU institutions. As shown in Figure 3, bilateral aid supporting development activities that identified adaptation as their principal objective has declined in recent years. For example, between 2011 and 2013, only US$8.5 million was dedicated toward projects and programs in which climate change adaptation was the principal objective of the activity.

The vast majority of bilateral aid contributing to adaptation is classified as multisectoral, followed by water supply and sanitation. Despite the fact that coastal zones, freshwater, agriculture, fishing, forestry, and human health have been identified as key vulnerable sectors to climate change (MEPN, 2006), they have received relatively low attention, according to the OECD Rio Markers.

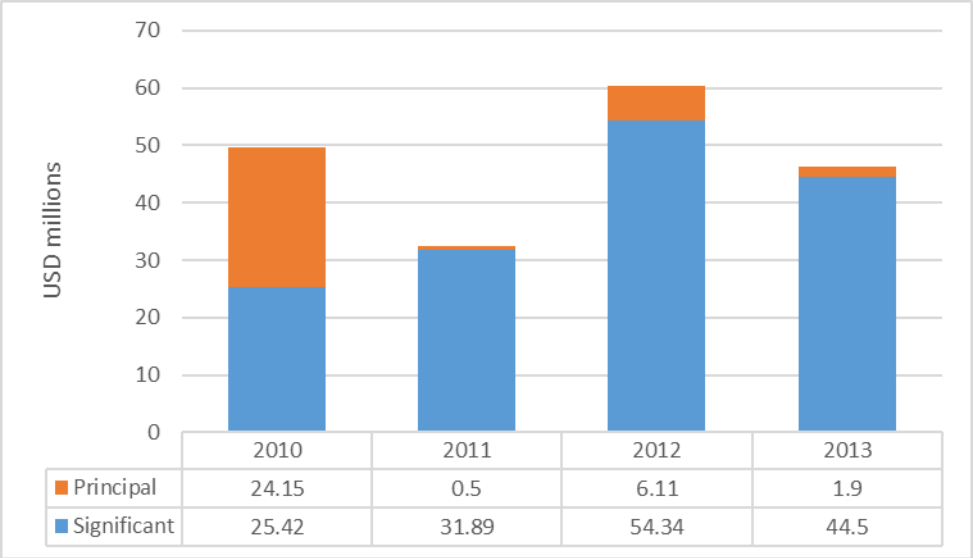


Figure 3 – Bilateral development aid identified as having as its principal or significant objective[40] support adaptation in Senegal between 2010 and 2013, in USD millions, with constant 2012 prices (based on OECD, 2015)

5. Networks and communities of practice

Adaptation planning and action can be advanced through civil society networks and communities of practice, as they can play an active role in promoting iterative learning, knowledge sharing, and capacity building. In Senegal, a number of these networks are led by Environment Development Action in the Third World (Enda Tiers Monde [ENDA-TM]), an international organization founded in Senegal that focuses on several themes related to sustainable development, including climate change. It forms a network in and of itself, as it is composed of decentralized branches in Africa, South America, and Asia. One of the networks ENDA-TM is involved in leading is AfricaAdapt, a community of practice that aims to raise awareness of and share knowledge on climate change between researchers, policymakers, and civil society organization across Africa. Interactions are both Web-based and face to face between its members and the public at large (AfricaAdapt, n.d.).

ENDA-TM is also part of the global Réseau Climat et Développement (Climate and Development Network), which aims to integrate climate and development issues. Created in 2007, the network counts 73 francophone NGOs in West Africa, North Africa, Mauritius, and France, and is coordinated by the Réseau Action Climat–France (Climate Action Network–

[40] Based on the definitions used by the OECD Rio Markers system, activities are considered to have supporting adaptation as their "principal" objective "when promoting the objectives of the UNFCCC is stated in the activity documentation to be one of the principal reasons for undertaking the activity. In other words, the activity would *not* have been funded but for that objective. Activities marked 'significant' have other prime objectives but have been formulated or adjusted to help meet climate concerns" (OECD, 2011, p. 2).

France) and ENDA Énergie. It aims to strengthen civil society influence and African francophone delegates in international climate negotiations; mainstream development issues into climate policies (and vice versa) in Africa; and promote the implementation of measures and policies that simultaneously tackle well-being, climate mitigation, and climate adaptation. It supports local projects and advocacy actions at the national and international levels (Réseau Climat Développement, n.d.).

ENDA-TM, under its Energy-Environment and Development thematic branch, also manages the Climate Action Network's regional hub for West and Central Africa. This advocacy network helps to facilitate networking and build the capacity of its members on a range of topics, including climate change adaptation. It was formed in 2008 and counts 41 member organizations, covering 18 countries speaking French, English, and Portuguese (Climate Action Network West Africa, n.d.).

Another important NGO in Senegal is the Senegalese Ecological Monitoring Centre,[41] which has been playing a key role in climate adaptation in the country. As previously noted, it has been accredited as a national implementing entity by the Green Climate Fund and the Adaptation Fund Board, and received funding from the Adaptation Fund to implement a coastal erosion project.

In terms of national networks, the Parliamentary Network for Environmental Protection in Senegal (REPES),[42] initiated in 1998 with support from the International Union for Conservation of Nature (IUCN), aims to help local and national government stakeholders promote sustainable development and good governance. Many parliamentarians and senators participate in and contribute to REPES. Its objectives include raising awareness of and knowledge on environmental issues, helping to defend public interests in environmental and natural resource management, and promoting better cooperation between NGOs and institutions in the area of environmental protection. Much of its focus is on the littoral zone (REPES, n.d.).

6. Conclusions

Senegal is considered to be among the countries most vulnerable to climate change, in part due to its continued development challenges and its exposure to climate risks such as droughts and floods. Of particular concern is the extent to which sea levels along the country's long coastline will rise, given that this area is home to the majority of Senegalese; includes a number of large urban centres; and is the location of several the country's key economic sectors, including fisheries, tourism, agriculture, and industry. Sea level rise is likely to lead to further damage to coastal infrastructure, low-land flooding, and saline

[41] Centre de Suivi Ecologique.
[42] Réseau des Parlementaires pour la Protection de l'Environnement au Sénégal.

intrusion, with implications for access to fresh potable water and for agricultural soils. In the country's arid areas, rising temperatures will increase the rate of evaporation and subsequently influence the availability of surface water and groundwater sources. This has direct implications for the millions of Senegalese smallholder farmers, agro-pastoralists, and pastoralists, many of whom already struggle with soil degradation, low productivity, and limited access to infrastructure and social services.

In light of these concerns, the GOS, through its NAPA, National Communications, and INDC, has identified the water, agriculture, fisheries, health, and tourism sectors, as well as coastal and arid regions, as priority areas for adaptation action. The actions identified by the GOS to reduce the vulnerability of these sectors are often consistent with those needed to manage current climate risks and meet existing development goals. The majority of discrete adaptation projects and programs being implemented in the country focus on meeting the needs of smallholders, as well as those engaged in artisanal fisheries. The need to improve the resilience of infrastructure, particularly in urban areas at risk of flooding, is also a focus of ongoing initiatives. As well, a number of projects are aimed at improving access to climate information and strengthening capacity at the national and local levels to prevent and manage disasters.

Less attention has been given to other sectors that are likely to be impacted by climate change. For instance, tourism is noted as being vulnerable to climate change, but there does not appear to be a strong strategy in place to reduce the vulnerability of the sector. Health was identified as a priority sector, but specific projects focused on reducing vulnerabilities within this sector were not identified through this review. Greater effort could also be directed toward enhancing adaptive capacity within the country's freshwater fisheries, as well as further addressing the needs of small-scale fishers along the coast. Likewise, given that 23% of Senegal's population resides in Dakar, and the city's population is set to continue to expand, greater attention could be given to building resiliency within it and the country's other coastal urban centres. In addition, although efforts are under way to strengthen access to climate information, greater research is likely required to understand the potential impacts of climate change on water resources, fisheries, forestry, and crop and livestock production, as well as to identify effective adaptation strategies. Recent initiatives such as those initiated under the CARIAA program could help to address these knowledge gaps.

The GOS has made some effort to put in place a governance framework to support action on climate change, including adaptation. This includes completing its NAPA in 2006, recently initiating its NAP process, and forming the COMNACC. However, the country has not taken any steps toward the establishment of a more comprehensive national climate change policy or strategy. Moreover, concern has been expressed that support for climate change action at the higher political level remains weak (Sall et al., 2011). While some plans have been developed, their implementation to date has been limited.

These observations are reflected in the limited extent to which climate change adaptation thus far has been integrated into sectoral plans. The risk climate change poses for Senegal's water resources is recognized in the country's Action Plan for Integrated Water Resource Management, but specific adaptation measures that will be taken to reduce these risks have not been articulated. Similarly, the risk posed by climate change to the fishery and agricultural sectors has been acknowledged in their respective policies, but actions again remain to be identified. Recognition of climate change by sectoral ministries thus appears to be limited, and presents an area in which greater capacity building could be undertaken, particularly as Senegal embarks on its NAP process.

Moreover, despite Senegal's past decentralization efforts and the formation of COMRECCs, integration of climate change considerations into subnational policies and plans appears to be quite limited. While some ongoing efforts are striving to build additional capacity at this level, further effort is needed to enable local governments to engage in context-specific adaptation planning and action.

Senegal has an active civil society sector and a number of strong NGOs that enhance its capacity to engage civil society, the private sector, and governments in developing and disseminating information on climate change and the need to adapt. Further strengthening the role of civil society organizations in national climate change debates and programming could be a crucial step in improving national capacities to meet the challenge of climate change.

7. Annexes

Annex A: Methodology

This section presents the research parameters established to guide development of the standardized reviews of current adaptation action in the CARIAA program's countries of engagement. It sets forward definitions used in this study, particularly with respect to the identification, selection, and classification of programs and projects considered in the review. This methodology was previously developed by the International Institute for Sustainable Development to support a review of current and planned adaptation action in 12 regions, which was completed in 2011 for the Adaptation Partnership. Modest updates to this original methodology were made to support the current review undertaken for the CARIAA program. For more information, see Adaptation Partnership (2015).

A.1 Adaptation actions included in the review

Within the review, adaptation action was defined as "policies, programs, and projects designed and implemented specifically to address the current and projected impacts of climate change." Therefore, the review focused on examining policies, programs, and projects in which specific reference has been made to supporting adaptation to climate change or climate risk reduction.

Consistent with this definition, the review gave attention to discrete, time-bounded programs and projects designed and implemented specifically to support preparation for or implementation of practical adaptation actions within the broader context of achieving development objectives. Therefore, at least one of the following terms appeared in the title, goals statement, or objectives statement of each program or project included in the review: "adaptation," "climate change adaptation (CCA)," "climate risk management," or "climate vulnerability reduction."

Based upon these parameters, the following types of programs and projects were not included in the review: disaster risk reduction, prevention, or management projects, unless they specifically reference that this activity is being undertaken in support of CCA; primary scientific research studies (for example agrology, botany, or meteorology) on the potential impacts of climate change (for example on changes in crop production, glacial melt rates, or typhoon patterns); long-term monitoring efforts (whether climatic or socioeconomic) needed to inform decision-making; stand-alone workshops, conferences, and training programs; and capacity building to support participation in processes related to the UNFCCC (such as training for negotiators, enabling activities to prepare reports).

The following additional parameters were established to guide the selection of programs and projects incorporated in the study:

- *Official start date.* To ensure that only "current" projects were included in review, selected projects needed to have begun on or after January 1, 2012, with the

exception of projects that began before this date but were still ongoing as of January 1, 2015.

- *Official end date*. Ongoing projects are those who official completion day is on or after January 1, 2015. Projects completed after January 1, 2012, were classified as completed.
- *Funding characteristics*. Projects with a value of US$100,000 or more were included in the study. However, reflecting the greater level of adaptation action underway in Bangladesh and India, the minimum value of projects included in the reviews for these two countries was raised to US$250,000. Projects financed by international and domestic sources of funding were considered.

Additionally, identified projects were classified by geographical scale in accordance with the following definitions:

- Global: Projects involving countries throughout the world, including the profiled country.
- Regional: Multi-country projects within a particular subregion, be it a continent or subcontinental area (such as South Asia or West Africa), that includes the profiled country.
- National: Projects occurring within one country.

A.2 Type of project being undertaken

To better understand the orientation of the projects underway in the countries examined as part of the review, projects were classified by type using the following definitions:

- *Research*. Encompassing efforts to develop new knowledge or organize existing information so as to increase understanding of the links among climate change, human society, and ecosystems and inform adaptation decision-making.
- *Assessment*. Encompassing risk, impact, and vulnerability assessments, as well as monitoring of ecological and societal trends.
- *Capacity building*. Encompassing the provision of technical training, technical assistance, institutional strengthening, and education.
- *Knowledge communication*. Encompassing efforts to share information, knowledge, and practices related to CCA, including awareness raising and engagement of media.
- *Policy formation and integration*. Encompassing efforts to inform, develop, and implement CCA plans, strategies, frameworks, and policies at the local, subnational, national, and international levels.
- *Field implementation*. Encompassing physical measures to reduce vulnerability to the impacts of climate change, including the implementation of pilot projects, construction of infrastructure, development and modification of technologies, and management of physical resources.

- *Community-based adaptation*. Encompassing actions that directly engage community members in efforts to understand, plan for, and respond to the impacts of climate change.

A.3 Sector or area of focus

To further inform analysis of the range of adaptation action taking place in each country reviewed, programs and projects examined in the study were classified by sector using the following definitions:

1. **Food, fibre, and forests**. Defined as the management and use of terrestrial natural resources to directly improve human well-being. Its subcategories are:
   - *Agriculture*. Encompassing subsistence agriculture, commercial agriculture, and the rearing of confined domestic animals.
   - *Pastoralism*. Encompassing the use of domestic animals as a primary means for obtaining resources from habitats (UNEP, 2007), particularly in nomadic and semi-nomadic communities.
   - *Forestry*. Encompassing afforestation, reforestation, agroforestry, commercial forestry, community-based forest management, and woodland management.
   - *Fire management*. Encompassing monitoring, planning, and management to address the impact of fires on settlements and ecosystems, including forested and grassland ecosystems.
   - *Aquaculture.* Food production through the rearing of aquatic animals, such as fish, crustaceans, and molluscs, or the cultivation of aquatic plants in natural or controlled marine or freshwater environments.

2. **Ecosystems**. Defined as a system of living organisms interacting together and with their physical environment, the boundaries of which may range from very small spatial scales to, ultimately, the entire Earth (IPCC, 2001). Its subcategories are:
   - *Biodiversity protection*. Encompassing activities related to the maintenance of living organisms at various spatial scales, including the establishment and protection of parks and bioreserves.
   - *Ecosystem conservation*. Encompassing efforts to *maintain* the health of particular ecosystems, such as wetlands, grasslands, forests, mangroves, and coral reefs.
   - *Ecosystem restoration*. Encompassing efforts to *restore* the health of particular ecosystems, such as wetlands, grasslands, forests, mangroves, and coral reefs.

3. **Freshwater resources**. Defined as the management and use of freshwater contained in terrestrial ponds, lakes, rivers, and watersheds, among others. Its subcategories are:
   - *Freshwater fisheries*. Encompassing the catching, packing, and selling of fish and shellfish derived from lakes, rivers, and ponds, as well as through freshwater aquaculture.

- *Watershed management*. Encompassing management of the basins that supply water to different streams, rivers, lakes, and reservoirs, including integrated watershed management.
- *Freshwater supply*. Encompassing efforts to access and preserve freshwater for human consumption and use, including drinking water sources, groundwater resources, rainwater harvesting, and water infrastructure such as wells, dams, and dikes.

4. **Oceans and coastal areas**. Defined as the management and use of coastal areas and oceans. Its subcategories are:
   - *Coastal zone management*. Encompassing the management of land and water resources in coastal areas, including through integrated coastal zone management and the establishment and maintenance of coastal infrastructure.
   - *Marine management*. Encompassing the management and use of offshore ocean and sea resources.
   - *Marine fisheries*. Encompassing the catching, packing, and selling of fish, shellfish, and other aquatic resources found in the oceans and seas, including through marine and coastal aquaculture.

5. **Disaster risk management**. Defined by the United Nations International Strategy for Disaster Reduction (2009) as the "systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster" (p. 10). It includes emergency response measures, preparation for extreme events and early warning systems. No sub-categories were established in relation to this macro project category.

6. **Migration and security**. Defined as efforts to support the movement of people and maintain their personal security in the face of incremental climate changes or climate shocks.
   - *Migration*. Encompassing preparations for and responses to the potential movement of people from one location to another due to climate change impacts.
   - *Security*. Relating to personal security and freedom from violence, crime, and war due to natural and human-induced disasters (UNEP, 2007) and encompassing peace building, conflict reduction, and conflict avoidance.

7. **Gender**. Defined as the social attributes and opportunities associated with being male and female and the relationships between women and men, and girls and boys, as well as the relations among women and among men. These attributes, opportunities, and relationships are socially constructed and are learned through socialization processes (United Nations Entity for Gender Equality and the Empowerment of Women, n.d.). This category includes efforts to understand the vulnerability of women to the impacts of climate change, gender-sensitive adaptation strategies, and measures to improve the

situation of women at the local and policy level, including through gender mainstreaming. No subcategories were established in relation to this macro project category.

8. **Business**. Defined as the purchase and sale of goods and services with the objective of earning a profit. Its subcategories are:
   - *Tourism*. Encompassing the adjustment and development of tourist facilities and operations to account for current and future vulnerabilities, including these actions in relation to ecotourism.
   - *Private sector*. Encompassing potential impacts of climate change and potential adaptation strategies on the diverse activities underway in the portion of the economy in which goods and services are produced by individuals and companies including industry, mining, and other economic sectors.
   - *Trade*. Encompassing the exchange of goods and services within and between countries.
   - *Insurance*. Encompassing the development, testing, and adjusting of insurance and risk-management schemes, including weather-based index systems.

9. **Infrastructure**. Defined as the basic equipment, utilities, productive enterprises, installations, institutions, and services essential for the development, operation and growth of an organization, city or nation (IPCC, 2001). Its sub-categories are:
   - *Energy*. Encompassing energy-related systems and infrastructure, including small-scale and large-scale energy generation through hydroelectric power generation, wind, solar, and other forms of traditional and new energy sources, as well as transmission networks.
   - *Transportation*. Encompassing the components of the system required to move people and goods, including roads, bridges, railway lines, shipping corridors, and ports.
   - *Waste management*. Encompassing sanitation, sewage systems, drainage systems, and landfills.
   - *Buildings*. Encompassing actions related to built structures such as houses, schools, and offices, including changes to building codes, building practices, and green ways of construction.

10. **Human settlements**. Defined as a place or area occupied by settlers (IPCC, 2001). Its subcategories are:
    - *Peri-urban areas*. Encompassing the outskirts of urban centres and the transition zones between rural and urban areas.
    - *Urban areas*. Encompassing municipalities, towns, and cities, as well as areas in these centres (such as slums).
    - *Rural areas*. Encompassing villages and other small settlements, as well as rural landscapes and integrated rural development.

11. **Human health**. Defined as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity (WHO, n.d.). It includes efforts to assess vulnerabilities to and the impacts of climate change on human health directly and indirectly, and the development and implementation of appropriate adaptation strategies at the local, regional, and national levels. No subcategories were established in relation to this macro project category.

12. **Climate information services**. Defined as the production and delivery of authoritative, timely, and usable information about climate change, climate variability, climate trends, and impacts to different users at the local, subnational, national, regional, and global levels. It includes efforts to develop, adjust, and provide short- and long-term climate forecasts, including climate change projections, to different audiences. No subcategories were established in relation to this macro project category.

13. **Governance**. Defined as the institutions (laws, property rights systems, and forms of social organization) through which societies define and exercise control over resources (UNEP, 2007). Its subcategories are:
    - *Government*. Encompassing efforts to build the capacity of government officials, either at the national or subnational level, to prepare for and facilitate adaptation to climate change, including through the development of policies, plans, frameworks, and strategies, as well as the establishment and operation of climate change trust funds.
    - *Civil society*. Encompassing efforts to build the capacity of the public, including NGOs, to understand, prepare for, and respond to climate change.

14. **Social protection**. Based on DFID's definition of social protection, projects within this category focus on three sets of instruments to address chronic poverty and vulnerability:
    - *Social insurance*. Referring to "the pooling of contributions by individuals in state or private organizations so that, if they suffer a shock or change in circumstances, they receive financial support."
    - *Social assistance*. Encompasses "non-contributory transfers that are given to those deemed vulnerable by society on the basis of their vulnerability or poverty."
    - *Workplace safety*. Involves the "setting and enforcing of minimum standards to protect citizens within the workplace" (DFID, 2006, p. 1).

    Adaptation projects that focus on labour market interventions and social assistance would be included in this category. No subcategories were established in relation to this macro project category.

15. **Multisectoral**. Defined as actions that simultaneously address more than one sector in one or multiple locations. It includes efforts that address more than one sector, which are challenging to tease apart, and in the context of this review includes large, multi-

country projects in which the specific sector of focus is nationally determined and, therefore, varies from country to country. No subcategories were established in relation to this macro project category.

16. **Other**. To capture areas of focus not clearly identified in the previous categories.

Annex B: Projects and programs

Projects working to address vulnerability to the impacts of climate change in Senegal are presented alphabetically in the table below.

Name of project	Objectives	Funder(s) and budget	Implementing agencies	Type of project	Sectors	Duration	Scale and location(s)
Adaptation to Coastal Erosion in Vulnerable Areas	To offset the impacts of sea level rise, the project aims to protect houses and economic and cultural infrastructure from coastal erosion. This includes the preparation of feasibility studies for coastal protection facilities, the implementation of protection measures, and the development of regulations that incorporate climate change considerations. The project was implemented in the communities of Rufisque, Saly, and Joal.	Adaptation Fund US$8.619 million	Ecological Monitoring Centre, Environment Directorate, various NGOs and community associations	Assessment; policy formation and integration; field implementation	Coastal zone management	January 2011–December 2014	National
Capacitating African Smallholders with Climate Advisories and Insurance Development	The project aims to increase smallholder farmers' use of climate information as they engage in seasonal agricultural decision-making. This goal will be achieved by building the capacity of both farmers, to access and use climate information, and boundary partners (such as national hydrometeorological organizations), to provide advisory services. The project also aims to increase access to index-based insurance.	CCAFS	World Agroforestry Centre, International Crops Research Institute for the Semi-Arid Tropics, University of Reading, Le Centre Régional AGRHYMET, Jet Propulsion Laboratory, Washington State University, University of Ghana, International Research Institute for Climate and Society, Agence	Capacity building; knowledge communication; field implementation	Agriculture; climate information; insurance	Unknown–2019	Regional Burkina Faso, Ghana, Mali, Senegal

			Nationale de l'Aviation Civile et de la Météorologie				
Climate Change Adaptation and Sustainable Water Management in Senegal	The project's main goal is to increase the resilience of agricultural systems and associated value chains to the impacts of climate change on the water sector. The project contributes to ensuring the availability of water for agricultural use in anticipation of increasing water scarcity. This will be addressed via three different activities: investing in capacity building, awareness raising, and knowledge management at a national policy level; improving water harvesting and watershed management by capturing surface water and supporting sustainable management of water resources; and promoting water conservation and efficient irrigation.	LDCF, International Fund for Agricultural Development US$13.945 million	Ministère de l'Agriculture et de l'Equipement rural, Ministère de l'Hydraulique et de l'Assainissement, Ministère de l'Environnement et de la Protection de la Nature	Capacity building; knowledge communication; field implementation	Agriculture; watershed management; freshwater supply; government	January 2012–January 2016	National
Climate for Development in Africa	The program aims to increase the climate resilience of Africa's population by addressing the need for improved climate information in Africa and strengthening the use of such information for decision-making. Climate for Development in Africa is an initiative of the African Union Commission, the United Nations Economic Commission for Africa, and the African Development Bank.	European Union, Finland, Nordic Development Fund, Sweden, UK Aid, United States Agency for International Development (USAID) €8 million	African Climate Policy Centre	Research; capacity building; knowledge communication	Climate information	January 2012–December 2015	Regional Ethiopia, Kenya, Tanzania, Uganda, Burkina Faso, Ghana, Mali, Senegal, Botswana, Namibia, South Africa, Egypt
Collaborative Management for Sustainable Fisheries in	The goal of the project is to reform Senegal's fisheries sector by improving governance capacity and providing effective tools for fisheries	USAID	Ministère de la Pêche et de l'Economie maritime, Coastal	Assessment; field implementation; policy formation and integration	Marine fisheries	February 2011–September 2016	National

Senegal	management. Assessing vulnerability to climate change and supporting adaptation planning are identified as specific areas of focus for the project.		Resources Center (University of Rhode Island)				
Decentralising Climate Funds in Mali and Senegal	This project will support more effective climate adaptation planning and finance by local governments in Mali and Senegal to improve communities' resilience to climate change.	DFID through the Building Resilience and Adaptation to Climate Extremes and Disasters program	Near East Foundation; International Institute for Environment and Development; Innovation, Environnement, Développement en Afrique	Knowledge communication; policy formation and integration; field implementation; community-based adaptation	Disaster risk management; government	2015–2017	Regional Mali, Senegal
Disaster Risk Management and Climate Change Adaptation	The project's overall aim is to mainstream climate change adaptation and disaster risk management in Senegal. It will develop and strengthen the capacities of the Civil Protection Directorate to engage in risk prevention and responses, manage the National Platform for Disaster Risk Reduction, and engage relevant stakeholders. It also supports the creation of an inter-ministerial operational centre to manage crises and an early-warning system to manage multiple risks, but with a particular focus on floods.	World Bank through Global Facility for Disaster Reduction and Recovery US$5.0 million	Civil Protection Directorate	Capacity building; knowledge communication; policy formation and integration	Disaster risk management; climate information; government	2012–May 2015	National
Ecosystems Protecting Infrastructure and Communities	The overall goal is to catalyze and promote improved management of ecosystems and harness multiple ecosystem services to protect vulnerable communities from risks associated with climate change and natural hazards. Its objectives are to: (1) demonstrate the effectiveness and economic value of environmental management for disaster risk	Germany's Federal Ministry of the Environment, Nature Conservation and Nuclear Safety through the International Climate Initiative	Coordinated by IUCN working closely with the University of Lausanne (Switzerland); l'Institut National de la Recherche Agronomique (France); the	Research; capacity building; knowledge communication; community-based adaptation	Ecosystem conservation; ecosystem restoration; disaster risk management; multisectoral; other: ecosystem-based	September 2012–August 2017	Global Nepal, Burkina Faso, Senegal, China, Chile, Thailand

	reduction and climate change adaptation; (2) raise awareness on the potential of environmental management to address disaster risk reduction and climate change adaptation; (3) work with communities to identify and implement local, nature-based measures for disaster risk reduction and climate change adaptation; (4) assist national and local governments in establishing and facilitating policy mechanisms; (5) disseminate lessons learned; and (6) build national, subnational, and local capacities for the implementation of ecosystem-based disaster risk reduction and climate change adaptation.	€4,004,645	Mangrove Action Project (Thailand); and the Swiss Federal Institute for Forest, Snow and Landscape Research		Adaptation		
Global Climate Change Alliance Regional Programme for West Africa	The overall goal is to support West African countries in tackling climate change so as to achieve their MDGs. The specific objective is to strengthen the capacity of national and regional stakeholders to mainstream climate change in development policies and strategies, and to implement measures to adapt to climate change and increase the resilience of the population. Components include monitoring, mainstreaming, and capacity building.	European Union through the Global Climate Change Alliance €4 million	Economic Community of West African States, Permanent Interstate Committee for Drought Control in the Sahel	Assessment; capacity building; policy formation and integration	Climate information; government	March 2011–February 2015	Regional Burkina Faso, Mali, Senegal, Benin, Cabo Verde, Chad, The Gambia, Guinea, Guinea-Bissau, Côte d'Ivoire, Liberia, Mauritania, Niger, Nigeria, Sierra Leone, Togo
Great Green Wall for the Sahara and the Sahel Initiative	The overall goal of the Great Green Wall initiative is to strengthen the resilience of people and natural systems in the Sahel and Sahara	World Bank, LDCF, Special Climate Change Fund, African	African Agency of the Great Green Wall	Capacity building; policy formation and integration; field	Agriculture; pastoralism; forestry; ecosystem	2011–unknown	Regional Ethiopia, Burkina

	regions through sound ecosystem management, sustainable development of land resources, protection of rural heritage, and improvement of the living conditions of the local population. The initiative has three main objectives: (1) improve the living conditions of populations in the arid zones of Africa and reduce their vulnerability to climate change, climate variability, and drought; (2) improve the state and health of ecosystems in the arid zones of Africa and their resilience to climate change, climate variability, and drought; and (3) mobilize resources for the implementation of the Great Green Wall Initiative through the establishment of efficient partnerships between national, regional, and international stakeholders.	Development Bank, FAO, European Union, the Global Mechanism of the United Nations Convention to Combat Desertification LDCF, Special Climate Change Fund, World Bank, and African Development Bank funds total US$3.108 billion; additional funds from European Union, the Global Mechanism of the United Nations Convention to Combat Desertification, and FAO		implementation	conservation; private sector; other: green infrastructure		Faso, Ghana, Mali, Senegal, Egypt, Algeria, Benin, Chad, Djibouti, Mauritania, Niger, Nigeria, The Gambia, Sudan, Togo
Integrated Management of Senegal's Coastal Areas: In-depth assessments and concrete measures for responding and adapting to climate change	The project aims to contribute to climate adaptation in the coastal zones of Senegal by establishing the foundations of an integrated coastal zone management plan to protect against erosion, in addition to concrete measures to protect the littoral zone. Results will include the development of geographical information systems to monitor the littoral zone, the creation of early-warning systems, and strengthening of the institutional and legal	European Union through the Global Climate Change Alliance €4 million	MEDD	Capacity building; policy formation and integration; field implementation	Coastal zone management	October 2010–October 2015	National

	framework through awareness raising and capacity building. Specific measures include building a drainage canal; restoring ecosystems, for example by planting mangroves to restore erosion barriers; collecting wastes; and starting a beach monitoring system.						
Live With Water: Capturing urban floodwaters for water stock and micro-gardening	The partnership builds the resilience of 920,000 vulnerable people to flooding through an innovative, integrated, and community-based approach. The approach incorporates interventions in three areas: (1) infrastructure (floodwater control, decentralized sewerage treatment, solid waste management, and urban gardening and greening); (2) policy (district flood contingency plans and national policy advice); and (3) capacity building (training and awareness building for beneficiaries and key stakeholders, with a special focus on empowering women).	DFID through the Building Resilience and Adaptation to Climate Extremes and Disasters program £8.7 million	Consortium pour la Recherche Économique et Sociale (lead organization)	Capacity building; knowledge communication; field implementation	Disaster risk management; urban areas	2014–unknown	National
Mainstreaming Ecosystem-based Approaches to Climate-resilient Rural Livelihoods in Vulnerable Rural Areas through the Farmer Field School Methodology	The project aims to enhance the capacity of the agro-pastoral sector to develop more climate-resilient production systems. It also aims to mainstream climate change adaptation into agro-pastoral and agricultural development policies and programs. It will improve knowledge and information sharing, pilot improved practices, build capacity and upscale resilient practices through a network of farmer field schools, and by mainstreaming adaptation strategies into national agricultural and animal production policy frameworks.	LDCF, GOS US$27.274 million	FAO, Ministère de l'Agriculture et de l'Equipement rural, MEDD, Agence Nationale de l'Aviation Civile et de la Météorologie, Ecological Monitoring Centre	Capacity building; knowledge communication; field implementation; policy formation and integration	Agriculture	2015–2018	National

Pathways to Resilience in Semi-Arid Economies	This project aims to spur climate-resilient development in African and Asian semi-arid lands by identifying economic threats and opportunities resulting from climate change. The project will work with stakeholders in government, business, civil society, and regional economic organizations to research five areas: climate risk, institutional and regulatory frameworks, markets, natural capital, and human capital. Focusing on practical needs, the project will shed light on climate risks and opportunities, leading to better-informed policies and investments for climate resilience.	DFID and the International Development Research Centre through CARIAA	Overseas Development Institute (UK); Innovation, Environnement, Développement, en Afrique (Senegal); Centre for Climate Change Studies, University of Dar es Salaam (Tanzania); Grantham Research Institute, London School of Economics (UK); Sustainable Development Policy Institute (Pakistan)	Research; capacity building; knowledge communication; policy formation and integration	Multisectoral	2014–2019	Global Pakistan, Tajikistan, Kenya, Tanzania, Burkina Faso, Senegal
Promoting Innovative Finance and Community Based Adaptation in Communes Surrounding Community Natural Reserves (Ferlo, Niokolo Koba, Senegal River Bas Delta and Saloum Delta), Senegal	Working in communes surrounding four community nature reserves, the project aims to promote community-based adaptation and sustainable financing mechanisms. It will achieve this objective by encouraging local governments and communities to integrate the additional cost of adaptation into the financing systems used by local governments and communities, and promoting inclusive access to natural resources through local government investments in structural adaptation measures and capacity building with community-based organizations.	LDCF, UNDP, and GOS US$22.51 million	UNDP; MEDD; Ministère de l'Economie, des Finances et du Plan	Capacity building; community-based adaptation; policy formation and implementation	Ecosystem conservation; government	Proposed	National
R4 Rural Resilience Initiative	The goal of this initiative is to enable vulnerable rural households to increase their food and income security in the face of increasing climate risks. It aims to develop innovative tools and strategies to	USAID, Norwegian Ministry of Foreign Affairs, Swiss Agency for Development	World Food Programme, Oxfam America	Community-based adaptation	Agriculture; insurance	2011–2017 (estimated)	Regional Ethiopia, Senegal, Malawi, Zambia

	reduce and mitigate risk due to climate variability and shocks so as to overcome hunger, achieve food security, and enhance resilience. Four risk management strategies are being pursued: "improved resource management through asset creation (risk reduction), insurance (risk transfer), livelihoods diversification and microcredit (prudent risk taking), and savings (risk reserves)" (World Food Programme, 2015).	and Cooperation, Swiss Re, Rockefeller Foundation, and ELMA Relief Foundation					
Stormwater Management and Climate Change Adaptation Project	The project aims to improve stormwater drainage and flood prevention in peri-urban areas of Dakar. It has three main components: mainstreaming flood risk management into urban planning, building capacity with local municipalities to improve investment in and management of drainage infrastructure, and engaging urban communities in flood risk reduction and adaptation.	World Bank and GOS US$72.9 million	Agence de Développement. Municipal	Capacity building; field implementation	Disaster risk management; waste management; peri-urban areas	May 2012–December 2019	National
Strengthening Land and Ecosystem Management Under Conditions of Climate Change in the Niayes and Casamance Regions	To project will improve the capacity of governments to implement ecosystem-based adaptation initiatives in the Niayes and Casamance regions and create a governance environment conducive to doing so. Project components include establishing a climate and socio-environmental information platform to help determine vulnerabilities and cost-effective adaptation options, reducing climate-driven risks in target ecosystems and lands through adaptive restoration measures, and developing knowledge and information support	LDCF, Government of Canada, GOS, UNDP US$47.95 million	UNDP, MEDD	Capacity building; knowledge communication; policy formation and integration; field implementation	Ecosystem conservation; climate information; government; other: ecosystem-based adaptation	June 2015–2019	National

	mechanisms.						
Strengthening the Resilience of Pastoralists and Agro-pastoralists through Trans-border Livestock Mobility	This project will strengthen the resilience of 905,000 pastoralists and agro-pastoralists (women, men, and children) by securing, servicing, and promoting trans-border livestock mobility across Mauritania, Senegal, Mali, Burkina Faso, and Niger; by providing key services (e.g., fodder supplements, animal health); and by enabling communities and stakeholders to lobby for livestock mobility and for appropriate policy-making at local, national, and regional levels.	DFID. European Union, Acting for Life £6.28 million	Acting for Life (lead organization)	Capacity building; knowledge communication; policy formation and integration; field implementation; community-based adaptation	Agriculture; pastoralism; civil society	2015–2017	Regional Senegal, Niger, Mauritania, Mali, Burkina Faso
Support for Sustainable Climate Change Adaptation in Marine Artisanal Fisheries Communities in West Africa	The project aims to promote the capacity of value chain actors in selected artisanal fishery communities to adapt to climate change. These interventions are expected to enhance the adaptive capacities and resilience of livelihoods built on artisanal marine fisheries in The Gambia, Senegal, and Sierra Leone.	FAO, Rural Foundation for West Africa US$318,000	National ministries responsible for fisheries	Capacity building	Marine fisheries	2013–2015	Regional Senegal, Sierra Leone, The Gambia

8. References

Africa Adapt. (n.d). About AfricaAdapt [Web page]. Retrieved from http://www.africa-adapt.net/en-us/about/

Au-Sénégal.com. (2015). Aperçu de l'agriculture sénégalaise. Retrieved from http://www.au-senegal.com/l-agriculture-senegalaise,359.html?lang=fr

Ba, M. (2015, April 10). Sénégal: Stratégie nationale pour l'équité et l'égalité du genre—Thiès prépare sa contribution au processus de révision. All Africa. Retrieved from http://fr.allafrica.com/stories/201504101728.html

Bureau d'analyses macro-économiques. (n.d). Documents officiels sur les politiques agricoles au Sénégal. Retrieved from http://www.bameinfopol.info/Documents-officiels-sur-les.html?lang=fr

Butterfield, R. (2011, March 30). Senegal: Climate overview. weADAPT. Retrieved from https://weadapt.org/knowledge-base/national-adaptation-planning/Senegal

Central Intelligence Agency (CIA). (2015). The world factbook: Senegal. Retrieved from https://www.cia.gov/library/publications/the-world-factbook/geos/sg.html

Christensen, J.H., Krishna Kumar, K., Aldrian, E., An, S.-I., Cavalcanti, I.F.A., de Castro, M., … Zhou, T. (2013). Climate phenomena and their relevance for future regional climate change. In T.F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, … P.M. Midgley (Eds.), Climate change 2013: The physical science basis. Working group I contribution to the fifth assessment report of the Intergovernmental Panel on Climate Change (pp. 1217–1307). Cambridge, UK: Cambridge University Press.

Climate Action Network West Africa. (n.d.). CAN West Africa. Retrieved from http://canwestafrica.endaenergie.org/

Climate Change, Adaptation and Food Security (CCAFS). (n.d.). Building climate risk management capacity in West Africa. Retrieved from https://ccafs.cgiar.org/building-climate-risk-management-capacity-west-africa#.V_P0w2grJmu

Climate Funds Update. (2015, April 30). The data: Climate finance recipients. Retrieved from http://www.climatefundsupdate.org/data

Coulthard, N.D. (2001). Senegal. In M.I. Evans & L.D.C. Fishpool (Eds.), Important bird areas in Africa and associated islands: Priority sites for conservation (pp. 733–750). Newbury and Cambridge, UK: Pisces Publications and BirdLife International. Retrieved from http://www.birdlife.org/datazone/userfiles/file/IBAs/AfricaCntryPDFs/Senegal.pdf

Daron, J.D. (2014). Regional climate messages for West Africa (Scientific report from the CARIAA adaptation at scale in semi-arid regions [ASSAR] project). Retrieved from http://www.assar.uct.ac.za/sites/default/files/image_tool/images/138/RDS_reports/climate_messages/West%20Africa%20Climate%20Messages%20-%20Version%201%20-%20Regional%20Level.pdf

De Vit, C., & Parry, J. (2011). Review of current and planned adaptation action: West Africa. Retrieved from https://www.iisd.org/pdf/2011/West_Africa_Adaptation_Action.pdf

Department for International Development (DFID). (2006). Social protection in poor countries. Social protection briefing note series, number 1. Retrieved from GSDRC website: http://www.gsdrc.org/docs/open/SP17.pdf

Diop, A. (2014, May). Le programme décennal de gestion des inondations (PDGI 2012–2022) une politique nationale articulée aux priorités du CAH. Presentation made at the 5ème Plateforme régionale africaine sur la Prévention des Risques et Catastrophes, Abuja, Nigeria. Retrieved from http://www.unisdr.org/files/37777_plenaryhfaandpoa4.senegal.pdf

Diouf, A. (n.d.). Why the decentralisation reform in Senegal? United Regions Organisation. Retrieved from http://www.regionsunies-fogar.org/en/join-oru/opinion-articles/65-why-the-decentralisation-reform-in-senegal

Environnement—le Sénégal met en place son fonds national climat (FNC) et compte mobiliser 60 millions de dollars US par an. (2015, May 2). Groupe Futurs Medias. Retrieved from http://www.igfm.sn/environnement-le-senegal-met-en-place-son-fonds-national-climat-fnc-et-compte-mobiliser-60-milliards-de-dollars-us-par-an/

Food and Agriculture Organization (FAO). (n.d.). Imports: Commodities by country: Senegal. FAOSTAT. Retrieved from http://faostat.fao.org/desktopdefault.aspx?pageid=342&lang=en&country=195

Fonds national climat: le Sénégal compte mettre 200 milliards pour la lutte contre les effets du changement climatique. (2015, May 4). Dakar actu. Retrieved from http://www.dakaractu.com/Fonds-national-climat-le-Senegal-compte-mettre-200-milliards-pour-la-lutte-contre-les-effets-du-changement-climatique_a89132.html

Fund for Peace. (2014). Fragile states index 2014. Retrieved from http://fsi.fundforpeace.org/rankings-2014

Government of Senegal (GOS). (1999). Stratégie nationale initiale de mise en œuvre (SNMO) de la Convention Cadre des Nations Unies sur les Changements Climatiques (CCNUCC). Retrieved from http://unfccc.int/resource/docs/natc/sennc1add1.pdf

Government of Senegal (GOS). (2014). Plan Sénégal émergent. Retrieved from http://www.gouv.sn/IMG/pdf/PSE.pdf

Intergovernmental Panel on Climate Change (IPCC). (2001). Annex B. Glossary of terms. In Climate change 2001: Impacts, adaptation and vulnerability. Retrieved from http://www.ipcc.ch/pdf/glossary/tar-ipcc-terms-en.pdf

Le Fur, A. (Cartographer). (2000). Carte 0a: Le Sénégal [Climatic region map]. In M.-C. Cormier, C. Gueye, A. Lericollais, & S.M. Seck, La construction de l'espace sénégalais depuis l'indépendance, 1960–2000. Paris, France: Institut de recherche pour le développement. Retrieved from http://www.cartographie.ird.fr/SenegalFIG/Senegal01.html

McSweeney, C., New, M., & Lizcano, G. (2010). Senegal. UNDP climate change country profiles series. Retrieved from http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/index.html?country=Senegal&d1=Reports

Ministère de l'Agriculture, de l'Hydraulique Rurale et de la Sécurité Alimentaire. (2006). Plan R E V A: retour vers l'agriculture: Nouvelle orientation de la politique agricole. Retrieved from http://www.bameinfopol.info/IMG/pdf/PlanREVA_150706_3_.pdf

Ministère de l'Economie maritime, des Transports maritimes, de la Pêche et de la Pisciculture. (2007). Lettre de politique sectorielle des pêches et de l'aquaculture. Retrieved from http://www.ntiposoft.com/domaine_200/pdf/lettre_de_politique_sectorielle.pdf

Ministère de l'Environnement et de la Protection de la Nature (MEPN). (2010). Deuxième communication nationale du Sénégal à la Convention Cadre des Nations-Unies sur les Changements Climatiques. Retrieved from http://unfccc.int/resource/docs/natc/sennc2.pdf

Ministère de l'Environnement et de la Protection de la Nature (MEPN). (2012). DECRET n° 2011-1689 du 3 octobre 2011. Retrieved from http://www.jo.gouv.sn/spip.php?article9403

Ministère de l'Environnement et du Développement Durable (MEDD). (2015). Contribution prévue déterminée au niveau national (CPDN). Retrieved from http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Senegal/1/CPDN%20-%20S%C3%A9n%C3%A9gal.pdf

Ministère de l'Hydraulique. (2007). Plan d'actions pour la gestion intégrée des ressources en eau du Sénégal. Government of Senegal. Retrieved from http://www.gwp.org/Global/ToolBox/About/IWRM/Africa/Senegal%20IWRM%20Action%20Plan%20(in%20French).pdf

Ministère de la Gouvernance locale, du Développement et de l'Aménagement du Territoire. (n.d.). L'acte III de la décentralisation. Retrieved from http://www.decentralisation.gouv.sn/?q=l%E2%80%99acte-iii-de-la-decentralisation

Ministère de la Pêche et des Transports Maritimes. (2001). Stratégie de développement durable de la pêche et de l'aquaculture. Tome II. Retrieved from http://www.oceandocs.org/bitstream/handle/1834/1711/P%C3%AAche-Aquaculture-Senegal.pdf?sequence=1&isAllowed=y

Ministère de la Santé et de la Prévention. (2009). Plan national de développement sanitaire PNDS 2009–2018. Retrieved from http://www.who.int/pmnch/media/events/2014/sen_pnds.pdf

Ministère de l'Intérieur et de la Sécurité Publique. (n.d.). Programme national de réduction des risques de catastrophe. Retrieved from http://www.interieur.gouv.sn/le-ministere/programmes-et-projets/programme-national-de-reduction-des-risques-de-catastrophe/

Ministère du Tourisme et des Transports Aériens. (2013). Plan stratégique de développement durable du tourisme au Sénégal (2014–2018). Retrieved from http://s411039637905c6a0.jimcontent.com/download/version/1454609350/module/9099025870/name/PSDDT_plan stratégique final 2014-2018.pdf

Mollard, É., & Walter, A. (2008). Suivre la décrue. In Agricultures singulières (pp. 27–48). Montpellier, France: IRD Éditions. Retrieved from http://books.openedition.org/irdeditions/2857

Nachmany, M., Fankhauser, S., Townshend, T., Collins, M., Landesman, T., Matthews, A., … Setzer, J. (2014). Senegal. In The GLOBE climate legislation study: A review of climate change legislation in 66 countries (4th ed.). London: GLOBE International & Grantham Research Institute, London School of Economics. Retrieved from http://www.lse.ac.uk/GranthamInstitute/publication/the-globe-climate-legislation-study-a-review-of-climate-change-legislation-in-66-countries/

Near East Foundation. (2015). Decentralising climate adaptation funds in Senegal. Retrieved from http://www.neareast.org/download/materials_center/Decentralisation-Senegal.pdf

Ndiaye, G.P. (2014). Session 4: Elément B: Eléments de la phase préparatoire: Expériences et les enseignements du Senegal. Presentation made at the NAP-GSP/PAG-PNA Africa Regional Training Workshop, Addis Ababa, Ethiopia. Retrieved from http://adaptation-undp.org/sites/default/files/senegal_experience.pdf

Ndiaye, M. (2007). Senegal agricultural situation country report [GAIN report no. SG7001]. Dakar: USDA Foreign Agricultural Service. http://apps.fas.usda.gov/gainfiles/200701/146279961.pdf

Ngaïdé, M., & Chambaz, R.C. (2007). Genre et décentralisation au Sénégal: Contribution à la réforme de la décentralisation. Dakar: IED Afrique. Retrieved from http://pubs.iied.org/pdfs/G03041.pdf

Noblet, M. (2013). Sénégal: Adaptation au changement climatique en zone côtière [Case study]. In Adaptation aux changements climatiques aux communautées du Nouveau-Brunswick. Moncton, New Brunswick: Université de Moncton, Faculté des Études Supérieures et de la Recherche. Retrieved from http://www8.umoncton.ca/umcm-climat/grain/4_6_senegal_adaptation_au_changement_climatique_en_zone_cotiere

Notre Dame Global Adaptation Index (ND-GAIN). (2015a). Country rankings. Retrieved from http://index.gain.org/ranking

Notre Dame Global Adaptation Index (ND-GAIN). (2015b). Senegal. Retrieved from http://index.gain.org/country/senegal

Organisation for Economic Co-operation and Development (OECD). (n.d.). Global alliance for resilience (AGIR)—Sahel and West Africa. Retrieved from http://www.oecd.org/site/rpca/agir/

Organisation for Economic Co-operation and Development (OECD). (2011). Handbook on the OECD-DAC climate markers. Retrieved from http://www.oecd.org/dac/stats/48785310.pdf

Réduire les risques de catastrophes en Afrique de l'Ouest. (2014, March 18). Reliefweb. Retrieved from http://reliefweb.int/report/world/r-duire-les-risques-de-catastrophes-en-afrique-de-louest

Réseau Climat Développement. (n.d.). Nos actions. Retrieved from http://climatdeveloppement.org/nos-actions/

Réseau des Parlementaires pour l'Environnement au Sénégal (REPES). (n.d.). Réseau des parlementaires pour l'environnement au Sénégal. Retrieved from http://www.repes.org/

Sall, M., Tall, S.M., Tandian, A., & Samb, A.A. (2011). Changements climatiques, stratégies d'adaptation et mobilités. Evidence à partir de quatre sites au Sénégal [Human settlements working paper series, rural-urban interactions and livelihoods strategies – 33]. London: International Institute for Environment and Development. Retrieved from http://pubs.iied.org/pdfs/10612IIED.pdf

Schaeffer, M., Baarsch, F., Balo, G., de Bruin, K., Calland, R., Fallasch, F., … Hare, B. (2015). Africa's adaptation gap 2: Bridging the gap—mobilising sources. Retrieved from http://apps.unep.org/piwik/download.php?file=/publications/pmtdocuments/-Africa%E2%80%99s_Adaptation_Gap_2__.pdf

Simonet, C., & Jobbins, G. (2015). Understanding patterns of climate resilient economic development: Senegal. London: Overseas Development Institute. Retrieved from https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/10108.pdf

Transparency International. (2014). Corruption perceptions index 2014: Results. Retrieved from http://www.transparency.org/cpi2014/results

United Nations Development Programme (UNDP). (n.d.-a). Intégration de l'adaptation au changement climatique dans le développement durable au Sénégal. Retrieved from http://www.sn.undp.org/content/senegal/fr/home/operations/projects/environment_and_energy/intac.html

United Nations Development Programme (UNDP). (n.d.-b). Supporting Senegal to advance their NAP process. Retrieved from http://adaptation-undp.org/projects/senegal-nap-process

United Nations Development Programme (UNDP). (2014a). Human development report 2014: Sustaining human progress: Reducing vulnerabilities and building resilience. Retrieved from http://hdr.undp.org/en/content/human-development-report-2014

United Nations Development Programme (UNDP). (2014b). Senegal. Retrieved from http://hdr.undp.org/en/countries/profiles/SEN

United Nations Entity for Gender Equality and the Empowerment of Women. (n.d.). Gender mainstreaming: Concepts and definitions. Retrieved from http://www.un.org/womenwatch/osagi/conceptsandefinitions.htm

United Nations Environment Programme (UNEP). (2007). Glossary. In Global environment outlook 4. Retrieved from http://www.unep.org/geo/geo4/report/Glossary.pdf

United Nations Framework Convention on Climate Change (UNFCCC). (2015). Report of the Green Climate Fund to the Conference of the Parties. Retrieved from http://unfccc.int/resource/docs/2015/cop21/eng/03.pdf

United Nations International Strategy for Disaster Reduction (UNISDR). (2009). 2009 UNISDR terminology on disaster risk reduction. Retrieved from http://unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf

World Bank. (2015a). Indicators [Data bank]. Retrieved from http://data.worldbank.org/indicator

World Bank. (2015b). Senegal: Country summary brief. Retrieved from http://siteresources.worldbank.org/EXTCDD/Resources/430160-1435154813801/Senegal_Country_Brief.pdf

World Food Programme. (2015). The R4 rural resilience initiative. Retrieved from https://www.wfp.org/climate-change/r4-rural-resilience-initiative

World Health Organization (WHO). (n.d.). Frequently asked questions. Retrieved from http://www.who.int/suggestions/faq/en/index.html

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