



How does climate exacerbate root causes of conflict in **Senegal**?

Climate Security Pathway Analysis

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This factsheet gives answers on how climate exacerbates root causes of conflict in Senegal, using a pathway analysis. Two main pathways are identified:

1. Livelihood and Food Insecurity: Climate impacts exacerbate existing socio-economic vulnerabilities, contributing to livelihood and food insecurity which, in turn, may increase the likelihood of radicalization and raise prospects for recruitment into armed and radical groups. Simultaneously, climate-induced livelihood and food insecurity in Senegal will likely intensify migration towards urban centres both inside and outside of the country.

2. Resource Availability and Access: The impact of climate change on land, water and food systems in Senegal undermines the availability of certain key resources which, apart from increasing livelihood insecurity, can impact the availability of natural resources and increase competition over access and use.

This publication is part of a factsheet series reporting on the findings of the CGIAR FOCUS Climate Security Observatory work. The research is centered around 5 questions*:

1 How does climate exacerbate root causes of conflict?

Climate Security Pathway Analysis

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3 What is the underlying structure of the climate, conflict, and socio-economic system?

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4 Are climate and security policies coherent and integrated?

Policy coherence analysis

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5 Are policy makers aware of the climate security nexus?

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Questions 1, 2, 3, 5 are analyzed at country level through a Climate Risk Lens (impact pathways, economic, spatial, network and social media analyses). The policy coherence and scopus analyses are at continental level.

*Scopus is one of the largest curated abstract and citation databases, with a wide global and regional coverage of scientific journals, conference proceedings, and books. We used Scopus data for analyzing: (1) how global climate research addresses the dynamics between climate, socio-economic factors, and conflict, and (2) how the countries studied are represented in the database.

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1. CONTEXT

Climate exposure and vulnerability

Senegal has a Sudano-Sahelian climate characterised by a dry season between November and May, and a rainy season from June to October. Precipitation in the country is distributed unevenly, the south receiving the highest annual rainfall with the rate decreasing towards the north. Climate trends show a decrease in precipitation and rising temperatures in the past few decades (MEDD 2015b).

Except for the greener Casamance region in the south, Senegal is located in an arid and drought-prone zone characterized by poor soil quality, adverse weather conditions and high vulnerability to climate change (University of Notre Dame 2020; CIAT & BFS/USAID 2016). The country suffers from both slow and rapid onset events, including droughts, floods, coastal erosion and a rise in sea-level (World Bank Group 2011; MEDD 2015b). Current estimates show that the climate in Senegal will become increasingly erratic. Projected is an increase in average temperatures of between 1.1°C and 1.8°C by 2035, and while there is agreement that the incidence of heavy rainfall events will increase, there is no consensus on whether annual rainfall will increase or decrease (MEDD 2015a, 2015b; World Bank Group 2011). As a consequence, extreme weather events such as droughts and floods will likely increase in frequency and intensity (World Bank Group 2011).

Senegal, with a 718 km long coastal strip, is also highly vulnerable to coastal degradation (Diatta 2022). This phenomenon is having a strong impact on infrastructure and the population, which primarily inhabits coastal areas that have a high concentration of human settlements. In the wider West African context, coastal areas host up to one third of the population and close to 60 percent of economic activities, such as fishing and tourism (Croitoru, Miranda and Sarraf 2019). The effects of coastal degradation includes river flooding, erosion and land loss, and air, water and soil pollution (Sarr 2016). Meanwhile, sea levels are projected to continue rising by 1.4 mm per year, with some estimates predicting a rise of up to one meter by 2100 (MEDD 2015b).

Conflict and fragility

Senegal is considered one of the most stable countries in Africa, experiencing far fewer conflicts or violence than other countries in the Sahel (FFP 2022). Since achieving independence in 1960, Senegal has had relatively stable civilian governments with peaceful transitions of power (BBC 2018b; World Bank 2021a). Nevertheless, the south of the country is the site of Africa's longest running armed conflict which, despite having evolved into a low-intensity war since the early 2000s and defined by some as a situation of "neither war nor peace", still presents a source of instability to some communities in Casamance (Madurga Lopez 2021; Serna 2015). Since 1982, the conflict in Casamance has pitted the Movement of Democratic Forces of Casamance (MFDC), which fights for the independence of the region, against the Senegalese government. The armed conflict has resulted in some 5000 deaths and thousands of displaced people and, in the last two decades, has been increasingly intertwined with illegal economies, mostly rosewood trafficking but also the cultivation of cannabis (Madurga Lopez 2021; Foucher 2019).

Despite being one of the few Sahelian countries where radical Islamism is not a salient issue and which has never suffered a terrorist attack of this nature, there has been recent incipient jihadist activity. The advance towards the west in neighbouring Mali of jihadist groups that are potentially seeking to enter Senegalese territory has raised concerns over the threat of radicalization spreading among the communities along the border (USAID 2017b; Pujol-Mazzini 2018; Counter Extremism Project 2020; Chair of the Security Council Committee 2021). Since the mid-2000s, illegal drug trafficking has become an increasingly salient issue, raising concerns that this could enable the financing of jihadist groups (Sandor 2016; Bird 2021).

Socio-economic

The Senegalese economy is strongly reliant on natural resources. The main exports include crude petroleum, minerals—mainly gold, fisheries-related products, and agricultural products such as groundnuts, cotton and tomatoes (OEC 2020; CIAT and BFS/USAID 2016). Agriculture, livestock and fisheries employ more than 22 percent of the workforce and contribute 15.3 percent of the GDP but they are also highly vulnerable and increasingly threatened by climate change (MEDD 2015b; World Bank 2021b, 2021c). The absence of adequate infrastructure, lack of access to quality seeds and fertilizers, poor soil quality and adverse weather conditions further burden the agricultural sector, curtailing its potential and ability to meet the food requirements of the country's growing population (CIAT and BFS/USAID 2016). This has led to a strong dependence on food imports, including key staple crops such as rice, since local rice production is only able to meet 35 percent of national consumption (CIAT and BFS/USAID 2016).

Fishing is one of Senegal's main economic activities, employing an estimated 17 percent of the workforce, and accounting for 1.8 percent of GDP and 32 percent of national exports (USAID 2017a). Fish are also crucial to food security and nutrition in the country, representing 47 percent of animal protein intake (WorldFish Center 2005). Over the past two decades, however, the fishing industry has suffered an acute crisis, witnessing a reduction in fish stocks along with a decline of the fishing sector's contribution to Senegal's GDP (MEDD 2015b; USAID 2009). Following the sale of fishing licences by the government in the 2000s, the reduction in fish stocks has been highly influenced by industrial fishing operations led by foreign vessels (Faye 2011; Standing 2015; USAID 2009, 2017b). Illegal fishing has also contributed to overfishing, leading to an estimated annual loss of USD 272 million (Blédé et al. 2015).

Despite having made notable development progress, Senegal still suffers from different socio-economic vulnerabilities. There is a 43 percent and 58 percent poverty rate in urban and rural areas, respectively. A total of 8.6 percent of urban and 15.1 percent of rural households are food insecure, of which 11.4 percent are moderately food insecure and 3.7 percent are severely food insecure in rural areas, while 6.6 percent are moderately food insecure and two percent severely food insecure in urban areas (WFP 2011). Poverty and food insecurity rates illustrate the strong rural-urban inequalities that are present in the country, which tend to spur migration towards the main urban centres. Levels of unemployment are at 2.9 percent while unemployment and underemployment together make up to 12.6 percent of the active workforce (ANSD and AFRISTAT 2019).

2. CLIMATE SECURITY PATHWAYS

Rising temperatures, increasing rainfall variability and ocean acidification are reducing crop yields, livestock productivity and fish stocks with detrimental effects to livelihoods and food security (as illustrated in the pathways) (ANACIM et al. 2013; CIAT and BFS/USAID 2016; MEDD 2015b). The Sahelian drought of the 1970s and 1980s had a devastating impact, particularly for rural communities who witnessed the loss of land, reduced availability of water resources, crop losses, livestock death and an overall intensification of food insecurity. Many of these rural households were forced to migrate to the main urban centres (Gueye et al. 2015). At present, worsening climate conditions and the increasing number of extreme weather events may, once again, have a strong detrimental impact on the availability of natural resources as well as on livelihoods by exacerbating existing risks and vulnerabilities. The impact can be categorised in two main pathways:

- Livelihood and food insecurity
- Resource availability and access

PATHWAY #1: Livelihood and Food insecurity

Climate impacts exacerbate existing socio-economic vulnerabilities, contributing to livelihood and food insecurity which, in turn, may increase the likelihood of radicalization and raise prospects for recruitment into armed and radical groups. Simultaneously, climate-induced livelihood and food insecurity in Senegal will likely intensify migration towards urban centres both inside and outside of the country.

The predominance of rainfed agriculture—less than five percent of cultivated land is irrigated—and the prevalence of smallholder farmers, most of whom cultivate rice, maize, millet and sorghum for subsistence, makes Senegalese agriculture particularly vulnerable to climate change (CIAT and BFS/USAID 2016). The risk is considerable taking into account that agriculture, livestock, and fisheries employ 22 percent of the workforce and contribute 15.3 percent of the GDP (MEDD 2015b; World Bank 2021b, 2021c). Rising temperatures, increasing rainfall variability and ocean acidification are reducing crop yields, livestock productivity and fish stocks with detrimental effects to livelihoods and food security (ANACIM et al. 2013; CIAT and BFS/USAID 2016; MEDD 2015b; USAID 2017a).

Droughts have also proven to have a strong detrimental effect on livelihood and food security, especially for rural communities who depend on climate-sensitive income-generating activities. Of the variation in total production of the main crops in the country (maize, millet, sorghum, rice and groundnut), 50 percent is explained by interannual rainfall variability, illustrating the strong link between climate change and agricultural output (ANACIM et al. 2013). There is also a strong correlation between production and food prices following harvests, which suggests that rainfall variability could contribute to food insecurity by increasing food price volatility (ANACIM et al. 2013). Droughts also impact livestock productivity and mortality, including through heat stress and by curtailing the availability of water resources and pastures as well as the production and quality of fodder, which, in turn, lowers meat and milk production and reduces herders' income (Seck and Laubin 2013; FAO 2016; MEPN 2006).

The Sahelian droughts of the 1970s and 1980s led to the loss of land, reduced the availability of water resources and resulted in crop losses, livestock deaths and an overall intensification of food insecurity (Gueye et al. 2015). More recently, the food security of an estimated 200 000 people was impacted by the severe drought in 2002, a figure that rose to more than 800 000 during the 2011-2012 drought, considered to be one of the worst in Senegal on record (ANACIM et al. 2013; Rigaud et al. 2021).

Between 1990 and the present, there has been a dramatic rise in the frequency of floods linked to intra-seasonal variability during the monsoon (ANACIM et al. 2013). Floods impact annually between 100 000 and 300 000 people (OCHA 2013). A flood episode in 2009 severely impacted the suburbs of Dakar, affecting 33 000 families (Gueye et al. 2015). Apart from the direct damage to communities, people also stress that the impact of floods has led to an increase in disputes between neighbours regarding the protective measures that need to be taken, as well as leading to a rise in criminal activity, rapes and assaults (Cissé and Sèye 2015). Moreover, floods in some cases may also undermine food stability where a high dependency on food markets is coupled with curtailed physical access to markets once the rainy season starts, especially when floods destroy infrastructure (ANACIM et al. 2013).

Climate impacts also contribute to the degradation of marine ecosystems and the overall decrease in fish stocks, exacerbating existing socio-economic vulnerabilities of people whose livelihood is connected to the fishing industry. Water temperatures have risen by 0.04 to 0.05 °C between 1980 and 2009, while Senegal's coastal water salinity has progressively increased (MEDD 2015a). Increases in water temperatures affect ocean productivity, alter marine currents and change the distribution, reproduction and migration of different species, pushing fish to migrate northwards towards colder waters (MEPN 2010; Cheung et al. 2021; World Bank 2013; Zickgraf 2018; USAID 2011, 2017b). The rise in water temperature also contributes to the deterioration of mangroves and corals, which are home to many species (Dia Ibrahima 2012; Zickgraf 2018). Meanwhile, increasing water salinity boosts acidification which, in turn, may lead to the loss of species that are particularly sensitive or not able to migrate, such as molluscs (Zickgraf 2018).

The intensification of existing climate trends, along with non-climatic factors, will continue to alter the environment of marine fauna, further reducing fish stocks and undermining the livelihoods of those that depend on it. It is projected that around 50 percent of jobs related to the fishing industry will be lost by 2050 in West Africa due to climate change, impacting livelihoods, purchasing power and the food and livelihood security of many people living along the coast (Belhabib et al. 2016).

The overall detrimental impact of climate change on livelihoods and food security may indirectly contribute to an increase in radicalization and recruitment by extremist armed groups. The common practice of Islam in Senegal, strongly influenced by Sufi brotherhoods, is considered inherently peaceful and is widely regarded as a bulwark against radicalization. Nonetheless, in recent decades, there has been an expansion of radical discourse mainly in the urban suburbs and in the regions bordering Mali. This is seen especially among the younger generation, precisely those considered highly vulnerable to climate impacts (Sambe and Ba 2013; Volk 2017). Several studies conducted by the Timbuktu Institute have shown that socio-economic factors are the most important drivers of radicalization in Senegal. In particular, poverty, unemployment and the lack of viable livelihoods and

income-generating activities have been identified as the main motives for joining jihadist armed groups (Sambe et al. 2021, Sambe et al. 2016; Sambe et al. 2018). Rather than a strong adherence to radical Islam, socio-economic frustrations and the expected economic benefits to compensate for worsening livelihood security may play a stronger role in the recruitment strategies of radical Islamist groups (Toupane et al. 2021; Sambe et al. 2021). Livelihood insecurity can also increase the likelihood of people, especially the youth, engaging in criminal and illicit activities such as banditry, robbery, illegal logging, illicit crops and different kinds of trafficking, undermining state capacity and increasing fragility and insecurity (USAID 2017b; Toupane et al. 2021).

Through its detrimental effect on livelihood and food security, climate change is also pushing people to migrate and seek alternative income-generating activities in the cities (Rigaud et al. 2021). Migration has always been a way of coping with various hardships in West Africa and elsewhere, including those related to economic shocks, security issues as well as environmental factors (Adepoju 2003; Rigaud et al. 2021; Diallo 2018). Recently, rural-urban migration has intensified across West African countries as farmers found it increasingly hard to sustain their livelihoods and were forced to seek alternative income-generating activities in the cities (Adepoju 2003; Goldsmith et al. 2004). Although Senegal has been considered for many years an attractive destination for migrants in the region, it has also experienced economic and political crises that have spurred out-migration of Senegalese nationals (Adepoju, 2003). Between 2002 and 2011, internal migration flows in Senegal increased by 23.9 percent (Rigaud et al. 2021).

Climate-related factors such as drought, desertification, flooding and coastal erosion have influenced and accelerated pre-existing migration patterns in different regions of Senegal (Zickgraf 2018). For instance, the severe Sahelian drought that occurred during the 1970s was a crucial factor in spurring rural-urban migration in the West Africa region, including Senegal (Grechi and Agustoni 2017). Hence, migration is usually an adaptation strategy to cope with climate-related risks, particularly used by the most vulnerable segments of the population (Liehr et al. 2016; Rigaud et al. 2021).

These trends are likely to increase in the coming decades with water stress and losses in crop productivity being particularly relevant in determining future migration (Rigaud et al. 2021). A recent study from the World Bank stresses that by 2050, internal climate migration in Senegal could rise to one million, encompassing 3.3 percent of the population. By this year, climate-induced internal migrants could exceed those who migrate because of development reasons (Rigaud et al. 2021). The main coastal urban centres such as Dakar, Thiès and Saint Louis are identified as the most important hotspots of climate-induced outmigration while the interior regions around Matam, Ziguinchor, Diourbel and Kaffrine are considered the main hotspots of climate-induced in-migration (Rigaud et al. 2021).

Migrants, who usually face a high degree of economic hardship, are sometimes also subject to the dynamics of exclusion, marginalization and discrimination by political institutions and receiving communities (Sarzana et al. 2023a). Migration is also considered to be linked with increasing environmental degradation, since the arrival of migrants is thought to be associated with short-term decision-making regarding the management of resources (Sarzana et al. 2023a). For these reasons, when local, national and regional level planning is inadequate, climate-induced migration

can exacerbate existing vulnerabilities in receiving areas and aggravate ongoing social tensions and increase conflicts (Rigaud et al. 2021).

Although most migration occurs regionally, especially within Senegal many people also migrate to Europe, mostly through irregular channels. The lack of job opportunities is one of the root causes pushing people to migrate irregularly to Europe and elsewhere in West Africa in search of alternate livelihood and work opportunities (Adepoju 2003; Jönsson and Kamali 2012; Cross 2009; Sall and Morand 2008). At the same time, the impact of climate is one of the factors contributing to the worsening of livelihood conditions of many Senegalese, including those dependent on fisheries (Deme and Ndiaye 2022; Zickgraf 2018; Belhabib et al. 2016; Lam et al. 2012).

While irregular migration happens across the country, the coastal regions of Dakar, Saint Louis and Thiès, where fishing is an important economic activity, have the highest sending rates (Republic of Senegal and EU). A recent study by the World Bank foresees these three coastal cities as becoming the main hotspots of climate-induced outmigration by 2030 and through to 2050 (Rigaud et al. 2021). This problem particularly affects young males who are mainly economically motivated, migrating in search of employment opportunities (MEPN 2010; Jönsson and Kamali 2012; Sall and Morand 2008; Republic of Senegal and EU). A recent study conducted by the Observatoire Sénégalais de Migrations showed that more than 60 percent of irregular migrants going to the Canary Islands were artisanal fishers-fishmongers, with unemployed people also being among the most common socio-professional groups (Deme and Ndiaye 2022). While migration has been widely recognized as an effective adaptation strategy against the impact of climate change, irregular migrants going to the Canary Islands are exposed to insecurity and extreme suffering and often die before reaching their destination (Gueye and Deshingkar 2020; Koser 2005; Peyton 2020).

Although migration is also associated with positive benefits both for receiving areas and for migrants themselves (Lacomba Vázquez et al. 2020; CES 2019), the presence of discriminatory discourses and polarising narratives has sometimes led to social tensions between migrants and local receiving communities, including harassment and attacks against newcomers (Canarias Ahora 2020; Vargas 2021; Martín 2021a, 2021b; Hernández and Vargas 2021). Some locals perceive migrants as competitors for economic resources, including jobs and government services, and believe that the arrival of migrants has a negative impact (CIS 2017). Meanwhile, migrants are sometimes left living in poor human conditions, which can contribute to increased grievances and resentment among them, further increasing social tensions and protests (Monreal Gainza and Paredes 2021; Defensor del Pueblo 2021; Martín 2021a).

Livelihood and food insecurity in Matam and Tambacounda

Matam and Tambacounda are among the most vulnerable regions of Senegal with most of their population relying on climate-sensitive livelihoods such as agriculture, fishing, and mining. While agriculture provides 70 percent of the employment and contributes to 40 percent of the regional GDP in Matam, it is still mostly rainfed and based on traditional farming methods, making it highly vulnerable to changes in climate (FAO 2016). Annual mean temperatures in the two regions are projected to see an increase of 2°C by 2050, while average precipitation will decrease by between 9.2 and 10 percent, leading to more severe droughts (CIAT and BFS/USAID 2016; ANACIM et al. 2013).

Recent climate trends in Senegal show that climate conditions particularly exacerbate food insecurity in northern Tambacounda and southern Matam (ANACIM et al. 2013). For instance, rainfall variability and long dry spells affect crop production, while climate-related shocks impact livestock productivity and mortality by effecting the availability of water resources and pastures, increasing food and livelihood insecurity (Seck and Laubin 2013; FAO 2016).

By impacting land, water and food systems, climate change exacerbates food and livelihood insecurity in Matam and Tambacounda, regions which are already stressed by non-climatic factors and influenced by historical marginalization by both colonial and post-colonial governments (Ninot 2003; Grechi and Agustoni 2019; Sakho 2005). Poverty rates in the two regions—among the highest in the country—are greater than 50 percent and food insecurity rates are between 10 and 21 percent (ANACIM et al. 2013; WFP 2011). Natural resources are already afflicted by poor management practices, increasing competition over resources, and the politicization of land allocation (Seck and Laubin 2013; USAID 2017b). There is also a lack of access to markets and natural resources, an increase in disputes between farmers and herders as well as youth unemployment and disaffection (USAID 2017b; ANACIM et al. 2013). Simultaneously, the progress of jihadist groups towards the west in neighbouring Mali, and the potential for spillover into Senegalese territory, has raised concerns over the risk that Matam and Tambacounda could see the threat of radicalization spread in their communities (USAID 2017b; Pujol-Mazzini 2018; Counter Extremism Project 2020; Chair of the Security Council Committee 2021).

Livelihood insecurity can, in turn, contribute to feelings of resentment by local communities arising from the government's reduced attention and uneven distribution of resources to Matam and Tambacounda (USAID 2017b). A visible outcome of climate-influenced livelihood insecurity may be the growing number of people—especially the youth—engaging in illegal activities such as poaching, trafficking, and banditry as they search for alternative sources of livelihood (USAID 2017b). Radical Islamist groups could benefit from or even partner with existing illicit economies and groups engaged in criminal activities, undermining state capacity and contributing to aggravating the security situation (Toupane et al. 2021).

The youth in Matam and Tamacounda are extremely vulnerable, particularly due to the fact that 63.4 and 55.8 percent of young people between the ages of 15 and 35 years in the two regions, respectively, are neither in the education system nor employed. These figures are the highest in the country (ANSD and AFRISTAT 2019). If the region's youth seize on these feelings of resentment influenced by climate-induced livelihood insecurity, they risk becoming more vulnerable to anti-government narratives, including those advanced by Sahelian jihadi groups like Jamaa Nusra al-Islam wal al-Muslimin (JNIM) (Sambe et al. 2021; Toupane et al. 2021; USAID 2017b). A recent study by the Timbuktu Institute in Matam and Tambacounda showed that socio-economic factors are the most important drivers of radicalization. In particular, poverty, unemployment and the lack of viable livelihoods and income-generating activities were identified as the main motives for joining a jihadist armed group (Sambe et al. 2021).

Livelihood and food insecurity in Dakar

The impact of climate change on fish stocks as well as the devastating effect of floods exacerbates existing socio-economic vulnerabilities (unemployment, poverty and food insecurity) and contributes

to the livelihood insecurity of people living in the suburbs of Dakar, especially affecting the youth, who may become more vulnerable to radicalization and increase the prospects for recruitment into extremist armed groups. A joint report conducted by ECOWAS and the ISS found that it was precisely in the most impoverished neighbourhoods of Dakar that interviewees expressed more positive attitudes towards radical Islam, including the narrative that portrays Western countries as anti-muslim (Sambe and Ba 2013). The lack of economic opportunities has been identified as a main driver in the radicalization and recruitment of young Senegalese into extremist armed groups. A study by the Timbuktu Institute in the suburbs of Dakar found that the lack of employment opportunities and poverty are considered to be the two main drivers of the enlistment of the Senegalese youth into radical Islamist groups (Sambe et al. 2016).

Livelihood and food insecurity in Casamance

Climate change is also exacerbating food and livelihood insecurity in the southern regions of Casamance, which may push more young unemployed people to resort to alternative livelihoods linked to illicit economies—especially illegal logging—to complement or substitute agricultural activities, contributing to the degradation of natural resources and exacerbating instability and tensions in some local communities.

With comparatively more favourable climatic conditions compared to the north, Casamance is known for its biodiversity, land fertility and vast—although rapidly declining—forest cover. Casamance has been historically considered Senegal's 'breadbasket' since it contributes a considerable part of Senegal's agricultural production. It is the region with the largest production of cashew nut and the second highest production of rice and cotton (ANACIM et al. 2013; Marut 2015). However, the prevalence of climate-sensitive livelihoods in Casamance makes it particularly vulnerable to changes in temperature and rainfall patterns (Bacci and Diop 2015). Temperatures have been increasing in past decades and recent studies project that the annual mean temperature will increase by 1.6°C in Ziguinchor and 1.9°C in Kolda by 2050, while total precipitation will decrease by seven percent in Ziguinchor and 10 percent in Kolda by the same year (CIAT and BFS/USAID 2016; Sané et al. 2010). Salinization due to droughts and a rise in sea-levels will continue to increase, leading to further erosion and soil degradation near the coast and along the Casamance River, reducing farmland and agricultural production (ANAMIC et al. 2013; MEDD 2015; USAID 2017a; Sarzana et al. 2022b).

Furthermore, Casamance's northern agricultural systems are affected by wind- and water-driven erosion, land degradation, deforestation, reduced rainfall and bush fires; while in the southern systems salinization of rice fields, acidification of lowland soils, wind and water erosion, reduced rainfall and degradation of vegetation cover are observed. The cultivation of rice, a popular staple crop in Casamance, especially in subsistence farming, has already been impacted by declining precipitation and increasing levels of land and water salinity. This has reduced farmland and decreased yields in the regions of Ziguinchor and Kolda, which will worsen under current climate change projections (MEDD 2015; Manzelli et al. 2015; Ruë and Descroix 2015).

Through its impact on land, water and food systems, climate change is exacerbating food and livelihood insecurity in Casamance, which are already stressed by non-climatic factors mainly related to the continuing armed conflict between the Movement of Democratic Forces of Casamance (MFDC) and

the Senegalese government. The conflict has resulted in some 5000 deaths and displaced thousands of people and, in the last two decades, has been increasingly intertwined with illegal economies, mostly rosewood trafficking but also the cultivation of cannabis (Madurga López 2021; Foucher 2019). Casamance suffers from the highest food insecurity rates in the country, mostly ranging between 20 and 60 percent (WFP 2011). The percentage of young people between 15 and 35 years of age that are not in the education system nor employed reaches 32.4 percent in Ziguinchor, 55.6 percent in Kolda and 53.8 percent in Sédihou (ANSD and AFRISTAT 2019). A study in the city of Vélingara, in Casamance, by the Timbuktu Institute found that lack of employment opportunities and poverty were clearly the two main factors driving the youth to engage in criminal activities and banditry as well as radicalization (Sambe et al. 2018). Poverty and deprivation increase the susceptibility of males to recruitment by the MFDC and drive a higher migration rate, used as a strategy by families to address this risk. However, lower household support for female migration increases the risk for women exposed to conflict dynamics (Schaub and Auer, 2022).

While providing an alternative source of income for some people in the short term, in the medium to long term illegal logging is a strategy maladapted to climate change as it contributes to the unsustainable plunder of natural resources (Jones Sanchez 2020; Marut 2015). Apart from its negative socio-economic and environmental impact, illegal logging has created tensions and even violence among communities in Casamance, which have sometimes been exacerbated by unsuccessful environmental peacebuilding projects (Evans 2022; Marut 2015; EIA 2020; Jones Sanchez 2020). These inter-communal disputes usually bring younger generations, who are the ones that mostly benefit from illegal logging, into confrontation with the older generations, who usually profit less from this activity (Jones Sanchez 2020). While illegal logging has often been tolerated and even considered a legitimate activity by a considerable part of rural communities, more recently discourses that strongly criminalise tree fellers have gained greater traction (Evans 2022; Jones Sanche, 2020).

Participation in illegal logging and timber trafficking poses inherent risks, as it usually involves engaging with the rebel MFDC who largely control the business. The group has been known to issue 'permits' to allow the transport of timber to the Gambia, and have been reported to provide escorts through the territory they control, helping smugglers to avoid land mines (EIA 2020). Tensions and conflicts between young fellers and MFDC rebels have been reported on several occasions (Jones Sanchez 2020; Liffiran 2018). Unsuccessful cooperation with the rebels can put the lives of tree fellers at risk, as allegedly happened to 13 boys in 2018 (Liffiran 2018). Similar conflicts have also been reported between rebels and local communities, who are impeded from accessing and using forest resources for sustainable livelihoods (TRIAL International 2020). Ultimately, illegal logging is partly responsible for the depletion and degradation of natural resources; it also curtails development, perpetuates instability and contributes to accentuating tensions and insecurity in some communities of Casamance.

PATHWAY #2: Resource Availability and Access

The impact of climate change on land, water and food systems in Senegal undermines the availability of certain key resources which, apart from increasing livelihood insecurity, can impact the availability of natural resources and increase competition over access and use.

Rainfall variability, dry spells and droughts reduce the availability of water resources and affect crop production. Meanwhile, these phenomena also impact the pasture and water resources that are needed by the herds, reducing livestock productivity and mortality (Seck and Laubin 2013; FAO 2016). As seen in the Ferlo region, located in northern Senegal, rainfall variability curtails livestock weight gain and milk production, leading to lower incomes and worsening the nutrition of some pastoralists, ultimately undermining local food security (Medina et al. 2022; Rigaud et al. 2021).

Farmers cope with increased water scarcity by expanding their fields, often encroaching on transhumance corridors and land that was historically devoted to pastoralism. Land encroachment by farmers obstructs the mobility of herders and curtails their access to water and pasture, creating tensions between both groups (Medina et al. 2022; Rigaud et al. 2021; World Bank 2020; Kitchell et al. 2014). At the same time, herders, who are among those most vulnerable to climate-induced food insecurity, are coping with the reduced availability of water by changing the timing of their mobility. Changes in these patterns brings them in closer proximity to farming communities at a time before the end of the harvest season, leading sometimes to the destruction of crops (Rigaud et al. 2021; World Bank 2020; Medina et al. 2022a). In fact, findings of the Pastoral Early Warning System (PEWS) show that since 2010 the mobility of pastoralists has been at record highs due to worsening environmental conditions and that the southwards migration of herds towards greener pastures and water resources is taking place earlier than usual (Rigaud et al. 2021). Overall, these changing patterns aggravate existing tensions and conflicts between both livelihood groups, such as those seen in the regions of Matam, Kolda and Kaffrine, which are often intertwined with ethnic rivalries (Rigaud et al. 2021; USAID 2017b; Medina et al. 2022).

Voices from the field: Fulani pastoralists from Thiel (Louga region)

Livestock herding represents the main livelihood for Fulani people living in the Ferlo desert, including those from the village of Thiel in Louga region. It is a key income-generating activity, essential for local food security and deeply rooted in the community's cultural practices. Transhumance, which remains the main livestock herding production system, is linked to seasonal mobility. Herders move southwards during the dry season in search of more humid zones to mitigate the harsher climate conditions with better pasturelands. During this time, they usually move temporarily to Kaffrine, a highly fertile region also known as the 'Peanut Basin'. Increasing interaction with farmers and agropastoral populations to the south of Ferlo has historically been one of the main risks of conflict in the form of farmer-herder disputes (Medina et al. 2022).

The impact of climate change also contributes to the degradation of marine ecosystems and an overall decrease in fish stocks, exacerbating existing socio-economic vulnerabilities of people whose livelihood is connected to the fishing industry. Water temperatures have risen by 0.04 to 0.05°C

between 1980 and 2009, while Senegal's coastal water salinity has progressively increased (MEDD 2015a). Increases in water temperature affects ocean productivity, alters marine currents and changes the distribution, reproduction and migration of species, pushing fish to migrate northwards towards colder waters (MEPN 2010; Cheung et al. 2021; World Bank 2013; Zickgraf 2018; USAID 2011, 2017b). Rising water temperatures also contribute to the deterioration of mangroves and corals, which are home to many species (Dia Ibrahima 2012; Zickgraf 2018). Meanwhile, increasing water salinity boosts acidification, which, in turn, may lead to the loss of species that are particularly sensitive or not able to migrate, like molluscs (Zickgraf, 2018).

Climate impacts can further suppress the availability of fish stocks and exacerbate existing conflicts and tensions over access to and use of resources between and among different users, such gold miners and fisherfolk as seen in Tambacounda and Kédougou, as well as between artisanal and industrial fishermen (Mbaye et al. 2022). The conflicts between artisanal fisherfolk and industrial fishing companies are posing an important threat to human security and sustainability. These are characterized by a strong imbalance of power, based on differing relationships with the government (DuBois and Zografos 2012). There are also several conflicts between different fishing communities who practice artisanal fishing, such as those that occurred between migrants and local fishers in Mbao and Ngaparou, as well as Saint Louis and Yarakh within Senegal, and between Senegalese fishermen from St. Louis and Mauritanian coastguards (DuBois and Zografos 2012; Beatley and Edwards 2018; Failler and Binet, 2010).

Voices from the field: Fisherfolk in the Carabane, Diogué, and Niomoune Islands (Ziguinchor)

The reduction of fish stocks has been exacerbated by industrial fishing operations led by foreign vessels and by illegal fishing. Climate impacts further undermine the availability of fish stocks and magnify existing tensions over access to and use of resources between different users, especially around artisanal fisherfolk and industrial fishing companies. To date, disputes between local fisherfolk from the Casamance River estuary and industrial fishers have not involved any form of violence, but resentment from locals towards industrial fishing is gradually building. Besides, the reduced availability of fish stocks has pushed some to cope with the hardship by going deeper into the sea, increasing the risk of injury, loss of equipment and death (Medina et al. 2022a).

Resource availability and access in Saint Louis

The negative effects of climate change on fish stocks may exacerbate existing socio-economic vulnerabilities and contribute to the livelihood insecurity of fishing communities in Saint Louis, pushing people to continue engaging in illegal fishing in neighbouring Mauritanian waters. This puts the safety of fisherfolk at risk while also potentially contributing to the escalation of conflict between adjacent Senegalese and Mauritanian communities living on each side of the border (USAID 2017b).

Although the relationship between Mauritania and Senegal has improved in the last three decades, tensions between the two countries escalated in 1989, forcing people to migrate and leading to retaliation and killings on both sides of the border. Senegalese residents in Mauritania, such as those living in Nouakchott, suffered attacks while Mauritanian traders and their property in Dakar and Saint Louis were targeted by local Senegalese (SWAC 2010; Magistro 1993). This led to hundreds of deaths,

thousands of refugees and displaced people and almost the start of war between the two countries (SWAC 2010; Magistro 1993).

The Senegal River Delta, where the city of Saint Louis is located, is subject to different climate impacts, including droughts, floods, sea level rise and coastal erosion (Sambou et al. 2020). UN-Habitat described Saint Louis as the city most threatened by sea level rise in the whole African continent (BBC 2008). Recent studies show that in Saint Louis fishing is the economic activity that has been most impacted by climate change and that fishing is the most climate-vulnerable occupation (Sambou et al. 2020).

The reduced availability of resources in northern Senegalese waters, influenced by climate change, has pushed some fisherfolk to cope with the hardship by moving northwards and fishing in Mauritanian waters (Belhabib et al. 2014; Deme and Ndiaye 2022; Zickgraf 2018). However, in the last decade Mauritania has adopted a stricter policy and it is now less tolerant with these practices which, apart from becoming increasingly dangerous, also constitute a source of conflict, mainly between Senegalese fishers and the Mauritanian authorities (Deme and Ndiaye 2022; Hallaire 2015). Mauritanian authorities have responded with numerous fines, arrests, beatings and even gunshots to warn off Senegalese fishers (Hallaire 2015; Zickgraf 2018). The lack of access to Mauritanian waters has led to increasing frustration among Senegalese fisherfolk in Saint Louis, who feel abandoned by the government (USAID 2017b).

Still, most fishers take the risk, crossing the maritime border at night with their lights off hoping to avoid the coastguards, which sometimes leads to boat collisions and various accidents, further increasing the risks (Hallaire 2015; Deme and Ndiaye 2022; Daïm 2012). The continuation of this trend, exacerbated by climate impacts, will increase the livelihood insecurity of Senegalese fisherfolk living in Saint Louis and continue to push them towards Mauritanian waters which, in turn, may boost the grievances of the Senegalese and become a source of violent tensions between both communities. In fact, the killing of a Senegalese fisherman by a Mauritanian coastguard in 2019 ignited attacks on Mauritanian-owned businesses in the border city of Saint Louis, a reminder of the tragic events that similarly took place in 1989 (Alonso Cabré 2019; BBC 2018).

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CGIAR aims to address gaps in knowledge about climate change and food security for peace and security policies and operations through a unique multidisciplinary approach. Our main objective is to align evidence from the realms of climate, land, and food systems science with peacebuilding efforts already underway that address conflict through evidence-based environmental, political, and socio-economic solutions.