COMMUNITY VOICES ON CLIMATE, PEACE AND SECURITY

SENEGAL

CGIAR FOCUS Climate Security

CGIAR INITIATIVE ON Climate Resilience

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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.

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INITIATIVE ON
Fragility, Conflict, and Migration

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Climate Resilience

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Agricultural Landscape Research
(ZALF)

EXECUTIVE SUMMARY

This Community Voices on Climate, Peace and Security series report, under CGIAR´s Climate Resilience Initiative, presents the results of a participatory appraisal conducted with residents of five localities across Senegal:

1. pastoral, agro-pastoral and farming communities in the drylands areas of **Louga**;
2. farmer and agro-pastoral communities in **Kaffrine**;
3. fishing communities on the **islands of the coastal area** of **Casamance**;
4. relocated fishing communities in **Saint Louis**; and
5. displaced farming communities in the **tropical forests** of **Casamance**.

A total of 99 community members (52 men, 47 women) participated in 19 FGDs, held throughout November of 2022 and June of 2023, across the five localities.

Climate-related security risks in Senegal

Senegal's vulnerability to climate change is evident in the rising temperatures, shifting precipitation patterns, and sea-level rise that impact the country. These climate-related challenges disproportionately affect vulnerable populations, particularly those in rural areas. The consequences of these climatic changes are intensifying the existing vulnerabilities of local communities and exacerbating issues related to societal stability and conflict.

Climate change-induced resource scarcity, such as limited access to water and arable land, can lead to disputes within and between communities. The threats posed by climate change to agricultural livelihoods are also undermining the ability of local communities to collaborate in addressing climate-related challenges, eroding social cohesion. In addition, climate-induced displacement and migration are becoming more common as people search for more habitable areas. This can potentially lead to conflicts over resources and increased pressure on urban centres.

The context of instability and conflict, particularly in regions like Casamance with a history of armed conflict, has reduced adaptive capacities due to the effects of violence. Nevertheless, Senegal, as a whole, remains relatively stable and peaceful compared to other regions in the Sahel.

Efforts to build resilience have been supported by collaborative actions between communities and a responsive government that engages with its local constituents. However, challenges such as economic informality, gaps in institutional capacity, limited access to public services, increasing inequality, and discrimination based on gender and ethnicity play an important intermediate role in materialising climate-related security threats. Addressing these challenges is crucial for enhancing resilience and reducing instability related to climate change in Senegal.

Six climate security pathways, as experienced by local populations, were identified:

- **Pathway 1:** Climate change threatens previously achieved progress in conflict management concerning the utilisation of natural resources by pastoralist communities.
- **Pathway 2:** A proliferation of unlawful activities among youth populations and low political legitimacy are exacerbated by the erosion of livelihoods attributed to climate-induced phenomena.
- **Pathway 3:** The loss of livelihoods increases the incidence of within-country and irregular cross-border migration, which poses security threats to people on the move.
- **Pathway 4:** Loss of livelihoods, food insecurity, and ineffective responses by state-authorities to climate threats undermine political legitimacy and exacerbate societal instability
- **Pathway 5:** A historical backdrop marked by conflict has significantly eroded the collaborative and adaptive capacities required for resilience-building in Casamance.
- **Pathway 6:** Accelerating coastal erosion is precipitating a series of challenges, including the reduction in available land and the heightened risk to both public and private infrastructure. These developments are stoking tensions among neighbours.

Community-led recommendations for conflict-sensitive resilience building

According to the perceptions of participants in this study, the climatic drivers of insecurity and instability are expected to intensify in the coming decades. The findings from this study strongly suggest that if these evolving insecurities are not effectively addressed, they may worsen in the face of more challenging climate conditions. However, it's worth noting that the management of natural resources and climate adaptation efforts can also serve as catalysts for cooperation among conflicting groups. Proposals for community-level adaptation activities are rooted in the specific social, environmental, economic and political characteristics of each case study area, the distinct climate threats faced by communities, and the nature of the group- and individual-level relations among local actors.

SAINT LOUIS

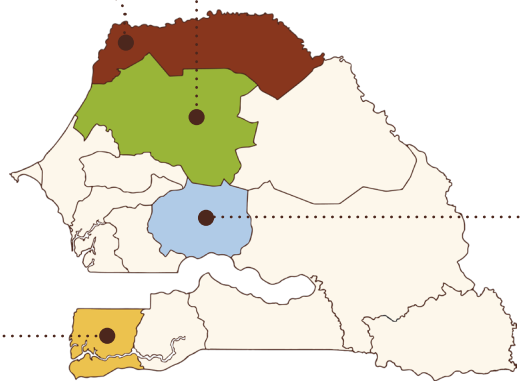
1. Implement security measures such as increased surveillance, increasing presence of police forces, and proper lighting to ensure the safety of residents and prevent any potential security threats.
2. Prioritise the development of basic infrastructure for effective public service provision, mainly reliable drinking water and electricity in Diougob.
3. Ensure fairness and equality in the distribution of aid and allocation of newly built houses in the resettlement project.
4. Increase collaboration between municipal authorities charged with public transportation to improve bus schedules between Diougob and “Langue de Barbarie” as a means of supporting fishing-related livelihoods.
5. Establish strict anti-corruption measures, strengthen public participation and promote transparency as part of the resettlement project.
6. Strengthen regulations and enforcement to reduce the negative effects of industrial and illegal fishing practices in Senegalese waters.

LOUGA

1. Safeguard the livelihoods of herding communities across agro-pastoral regions in Senegal through social protection and access to financial services.
2. Integrate a collaborative governance approach to the management of pastoral units across municipalities to increase the adoption of the organisational model, and to define locally-tailored regulations while maintaining a degree of consistency across main migratory routes.
3. Increase the capacity of herders on the move to comply with local regulations for transhumance processes. Participants proposed to strengthen the delineation of herding corridors and the creation of resting areas for herders on the move, where they could access all required information.
4. Diversify livelihoods by investing in infrastructure and capacities for milk processing. Focus in strengthening women´s participants across the value chain of mil.

KAFFRINE

1. Increasing engagement and cooperation across different livelihood groups is a crucial effort to mitigating transhumance-related conflict risks and promoting peaceful coexistence farmers and herders.
2. Increase access to irrigation water to facilitate dry season agriculture and expand labour opportunities for young people in regions like Kaffrine. Foster access to long-term joint credits and local capacities for collaborative and sustainable water management.
3. Develop climate information systems available to farmers and herders that integrate a focus on transhumance processes. Providing herders with information about local regulations and farming seasons, and farmers with insights into the needs and challenges of herders, can foster mutual understanding and cooperation.
4. Enhance local capacities for value-addition of agricultural produce and better access to markets through cooperative models.
5. Empower local communities to effectively coordinate with migrants, both within Senegal and abroad, as a valuable strategy for building resilience and leveraging migration as a positive force for community development.



CASAMANCE

1. Develop governance systems for collaborative coastal management and planning as a solution to maintain high-levels of social capital and protect fishing populations in Casamance.
2. Implement measures to organise the gradual retreat of populations from vulnerable shorelines or to prohibit construction in exposed areas. This demands a comprehensive approach that combines technical expertise, robust institutional capacity, and meaningful engagement with local communities.
3. Support the resettlement processes of former IDPs in the villages surrounding Ziguinchor, through infrastructural and technical assistance.
4. Empowering local communities to effectively coordinate with migrants, both within Senegal and abroad, is a valuable strategy for building resilience and leveraging migration as a positive force for community development.

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INTRODUCTION

The effects of climate change and conflict act as compounding and interrelated stressors over people's wellbeing. While it is widely acknowledged that climate change exacerbates ongoing conflicts by diminishing the adaptive capacity of societies and governments to address them effectively, numerous unanswered questions persist regarding the multifaceted connections between climate and conflict. There is a notable deficiency in locally contextualised and policy-relevant research that delves into the precise mechanisms through which climate-related security risks manifest in diverse geographical and social settings.

Moreover, existing studies on the intricate interplay between climate change and conflict often overlook the importance of local cultural and political realities. Consequently, the recommendations that emerge from such research tend to prioritise technocratic solutions and top-down governance structures, often at the expense of recognising and aligning with the perspectives, understanding, and priorities of local populations concerning peace and resilience.

A recent IPCC report (2022) recognises the pivotal role played by climate change in exacerbating vulnerabilities that are intrinsically tied to conflicts. It unequivocally underscores the need for climate adaptation strategies to function as a tool for addressing the adverse effects of climate change on factors that drive conflict, particularly by addressing issues of political and economic inequality. Adaptation to climate change should therefore integrate strategies to foster social cohesion, empower communities to build resilience, and enhance the relationship between states and societies.

In pursuit of a deeper understanding of the intersections between climate and security, the Community Voices on Climate, Peace and Security research initiative, conducted under CGIAR's Climate Resilience Initiative, embarked on an assessment of climate-related security risks and conflict-sensitive climate adaptation strategies as conceived by local populations in five different countries: Kenya, Senegal, Guatemala, Zambia (Southern Province), and the Philippines (Mindanao). This research initiative aims to bridge existing knowledge gaps in this critical area and shed light on the perspectives and insights of local communities.

The data collection methodology employed aligns with the principles of participatory appraisal, wherein community members assume the role of citizen scientists and experts in comprehending the diverse vulnerabilities and security-related challenges that affect their lives. This approach empowers them to actively contribute insights and recommendations for improvement. To facilitate this process, a range of collective reflection techniques, as documented in studies such as Rüttinger et al. (2014) and Ulrichs et al. (2015), were employed as a toolkit to design a participatory vulnerability

assessment that incorporates a focus on climate-related security risks.
This methodology combined tools previously utilised in participatory assessments of climate change vulnerability and conflict. The overarching objective was to uncover potential connections between climate and security by identifying vulnerabilities to climate impacts and security risks. Subsequently, this information was leveraged to develop resilience-building solutions rooted in collective action, with the ultimate goal of contributing to sustainable peacebuilding efforts within participating communities.

A conceptual framework for climate security

A recent review of the climate security literature, conducted by Buhaug and von Uexkull (2021), has proposed a conceptual framework for understanding the intricate relationship between climate change impacts and conflict. This framework (see Fig. 1) draws upon three well-established areas of scientific inquiry:

- Drivers of vulnerability to climate extremes and variability: This component delves into the factors that render societies vulnerable to the effects of climate change and variability. Socioeconomic vulnerabilities play a significant role in shaping a community's susceptibility to climate-related challenges.
- Climatic drivers of conflict risk: Here, the focus is on how climatic changes and their associated impacts can heighten the risk of conflict and societal instability, as experienced by local populations. This dimension examines how environmental factors can influence conflict dynamics.
- Societal and environmental impacts of conflict: The third component assesses the consequences of instability and conflict, both on society and the environment. These impacts can further exacerbate vulnerabilities to future climate hazards.

The proposed framework illustrates a complex interplay between these three components. Socioeconomic vulnerabilities influence the risk and severity of the impacts of climate extremes and variability. These climate-related impacts, in turn, can escalate or de-escalate the risk of armed conflicts. Furthermore, the ramifications of armed conflicts can amplify vulnerabilities to subsequent climate-related threats. This interconnection creates the potential for a society to become ensnared in a "vicious circle" of climate insecurity. Similarly, cooperation for resilience building can trigger an opposite, or "virtuous", cycle that contributes to peacebuilding and societal stability.

It's important to note that this framework is shaped by institutional responses at various levels and across diverse policy sectors, adding further layers of complexity to the interaction between climate change, peace and conflict.

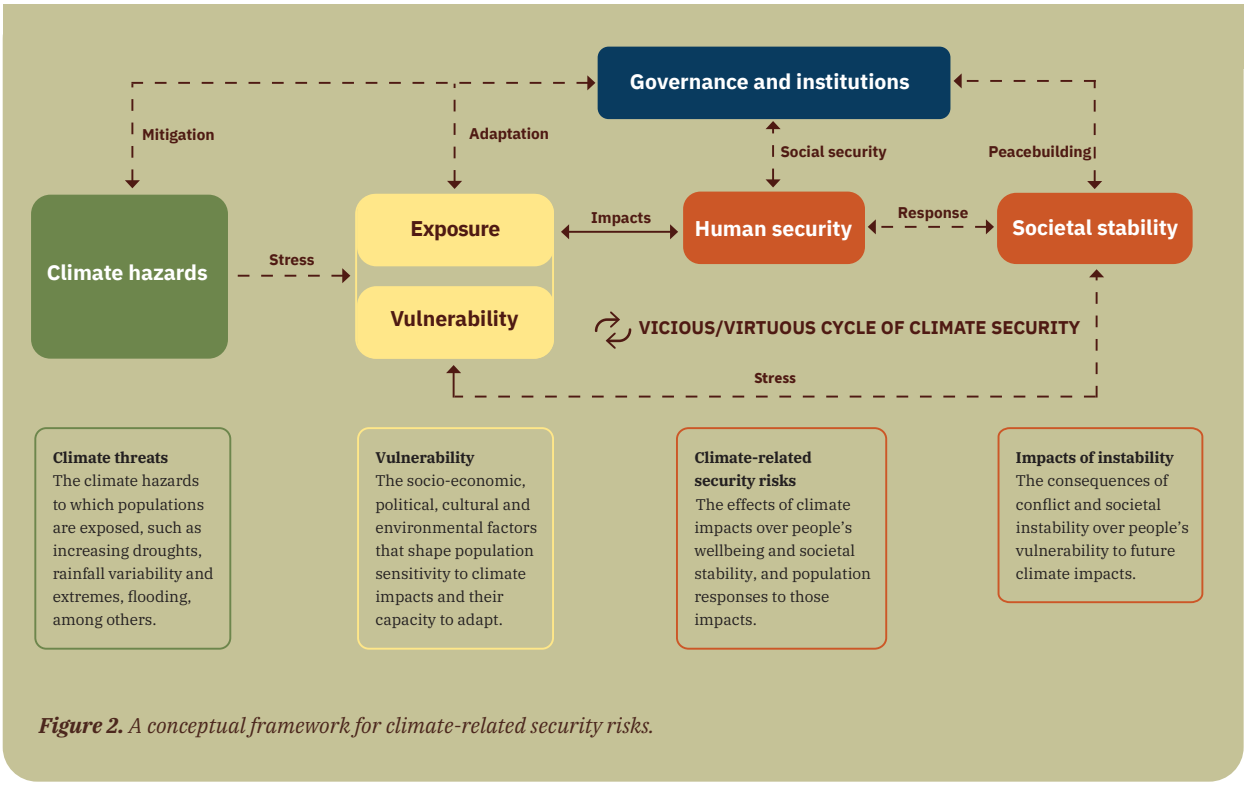

Figure 2. *A conceptual framework for climate-related security risks.*

Photo: *L. Medina / CGIAR*

Definitions

- **Adaptation:** In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities.
- **Adaptive capacity:** The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.
- **Climate Security:** Climate-related security risks are systemic risks emerging through interactions between ecological, social, political, and economic dimensions, and "driven by one or more climatic stressors that [directly or indirectly] challenge the peace and stability of states and societies" (Detges et al., 2020, p. 5).
- **Conflict-sensitive climate adaptation:** an approach to climate adaptation that seeks to avoid unintendedly making conflict situations worse and, when possible, aims to contribute to address the causes of conflict.
- **Exposure:** The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected.
- **Human security:** A condition that is met when the vital core of human lives is protected, and when people have the freedom and capacity to live with dignity. In the context of climate change, the vital core of human lives includes the universal and culturally specific, material and non-material elements necessary for people to act on behalf of their interests and to live with dignity.
- **Maladaptation:** Actions that may lead to increased risk of adverse climate-related outcomes, including via increased GHG emissions, increased vulnerability to climate change, or diminished welfare, now or in the future. Maladaptation is usually an unintended consequence.
- **Pathways:** Context-specific interactions between climate impacts and peace and insecurity risks.
- **Resilience:** Capacity of social, economic, and environmental systems to cope with a hazardous event, trend or disturbance by responding or reorganising in ways that maintain their essential function, identity, and structure while maintaining their capacity for adaptation, learning, and transformation.
- **Vulnerability:** The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

METHODOLOGY

The appraisal method applied in this study expands our comprehension of climate-related security risks in Senegal. It examines the way local actors capitalise on practical experience to elucidate their understanding of the environmental- and conflict-related collective problems they face; to reflect on their action strategies in addressing such problems; and to challenge institutional structures that sustain underlying causes of their vulnerability. Ongoing community-level responses are also discussed, identifying short-term coping and long-term adaptive strategies which have most successfully enhanced local capacities towards managing climate risks. The assessment took place through a qualitative multiple-methods approach combining direct observation, participatory group sessions, and open structure interviews. The appraisal method consists of an assessment integrating three phases (adjusted from Bonatti et al., 2018) each with the respective goal of:

1. Recognition of community knowledge: This phase aimed to identify and acknowledge community-level knowledge pertaining to social-ecological systems and climate change.
2. Definition of conflict and vulnerability drivers: The second phase sought to define the drivers of vulnerability to climate hazards and security-related risks. Importantly, this process was grounded in local experiences and traditions, ensuring a contextually relevant understanding.
3. Exploration of conflict-sensitive resilience building: The final phase explored opportunities for meaningful collective action that could simultaneously enhance resilience and contribute to sustainable peacebuilding efforts.

These phases were in turn made up of six steps (see figure 3 below), each using different appraisal tools to facilitate a joint reflexive dialogue with community members. The first and second phases were conducted through a transect walk and focus group discussions (FGDs) held separately for women and men, hence allowing for the identification of intersectional drivers of vulnerability and different perceptions of community-level responses to risk management strategies. Phase 3 on collective action planning was facilitated through working groups in which women and men were divided equally. Qualitative key informant interviews complemented the analysis. Each case study assessment was conducted over five days. Local languages and in-time translation were used throughout the FGDs to facilitate an inclusive dialogue. For further details on the method´s process, adopted tools and limitations, readers can refer to the document "Community voices on Climate and Security: a social learning approach" (Medina et al., 2023).

Phase 1: Recognising Community Knowledge

TOOL 1 **Transect Walk**

Context appraisal activity which includes a guided tour of the locality. Researchers ask community leaders to show them the most important sites for the community and its surroundings.

Output:
- Gain a better understanding of the main social, physical and ecological characteristics of the community and its surrounding area.
- Develop a profile of adaptive capacity and vulnerability in the community.

TOOL 2 **Historical Timeline**

Focus Group Discussion (FGD) meant to develop a graphical representation of most impactful events, changes and trends as recollected by community members.

Output:
- Map recent history of the community in terms of main political, socio-economic and environmental events as perceived by participants.
- Identify main trends in climate extremes and variability.
- Identify historical and recent trends in conflict dynamics.

Phase 2: Conceptualising Climate Security Risks

TOOL 3 **Seasonal Calendar**

Risk assessment tool that situates vulnerability in seasonal patterns. Participants map livelihood strategies throughout the year and identify risks to security in terms of access to resources, health, financial assets, safety and conflict.

Output:
- Profile of livelihoods and main socio-economic and environmental challenges.
- Characterise climate impacts over livelihood strategies and well-being.
- Map seasonal nature of risks, including conflict risks.

TOOL 4 **Problem & Solution Tree**

The problem tree defines the main conflict risks, and determines their direct and root causes. The solutions tree asks participants to identify ongoing community responses to the main causes of conflict.

Output:
- Shared understanding of underlying causes of conflict, and identification of structural drivers of conflict.
- Assessment of the potential role of climate impacts on the drivers of conflict.
- Identify ongoing adaptive responses, their operation and effectiveness.

Phase 3: Collective Action Planning

TOOL 5 **Collective Action Planning**

Working groups focus on prioritised security challenges and propose adaptive solutions that account for ongoing responses and rely on collective action.

Output:
- Potential solutions for prioritised security challenges.
- Actions to implement each solution, along with responsible actors and required external support.

TOOL 6 **Evaluation**

Participants are asked what they liked and disliked the most about the method.

Output:
- Participants perspective on the method's usefulness and impact as a tool to assess vulnerability and plan adaptive action.

Figure 3. *Research method phases and tools.*

This report presents the results of a participatory appraisal conducted with residents of five localities across Senegal: 1) pastoral, agro-pastoral and farming communities in the drylands areas of Louga 2) farmer and agro-pastoral communities in Kaffrine, 3) fishing communities on the islands of the coastal area of Casamance, 4) relocated fishing communities in Saint Louis, and 5) displaced farming communities in the tropical forests of Casamance. A total of 99 community members (52 men, 47 women) participated in 19 FGDs, held throughout November of 2022 and June of 2023, across the five localities.

The report is structured in five parts. Section 2 summarises the research context. Section 3 discusses climate and environmental change as perceived by community members throughout recent decades. It also assesses impacts of climate change over the community's wellbeing and ongoing adaptive responses. Section 4 discusses the different causal pathways through which climate change and security-related risks may be interlinked. Section 5 details the recommendations developed by community members for resilience building action that can potentially serve as an instrument for peace.

RESEARCH CONTEXT

How is climate change affecting Senegal?

Senegal has a Sudano-Sahelian climate with an arid and drought-prone territory characterised by poor soil quality, adverse weather conditions and a high climate-vulnerability (University of Notre Dame, 2020; CIAT & BFS/USAID 2016). Precipitations are unevenly distributed across the country with the greener south receiving the highest annual precipitation rates (MEDD, 2015). Its geographical location makes Senegal particularly vulnerable to both slow and rapid onset events, including droughts, floods, coastal erosion and sea-level rise (World Bank Group 2013; MEDD, 2015). All these events, coupled with socioeconomic vulnerabilities and environmental degradation, negatively impact climate-sensitive sectors, including those linked to land, water and food systems.

Food systems in Senegal, which encompass farming, livestock herding, and fishing, constitute a crucial source of income for 70% of the Senegalese workforce and contribute to more than 15% of the national GDP (MEDD, 2015). These sectors heavily rely on traditional production methods, with over 90% of cultivated land in the country being dependent on rainfall (Dièye, 2022). This dependence on rainfed agriculture renders the overall population highly vulnerable to unpredictable weather patterns.

Rainfall in Senegal exhibits a concentrated pattern, with the majority of precipitation occurring between June and August and gradually declining until October. The remaining months of the year are characterised by dry conditions. The distribution of rainfall plays a pivotal role in shaping livelihood activities across the country: agroforestry, cash crops, and rice cultivation are predominantly practised in the south; agro-pastoralism is the primary livelihood strategy in the central region, while silvo-pastoralism serves as the

predominant source of income in the northern areas. An exception in the north lies in the Senegal river basin, where agriculture is more widespread (FEWS NET, 2021). High-degrees of spatial and temporal variability in Senegal imply significant challenges for stable food production.

The adverse effects of climate change in Senegal have exacerbated an already challenging situation. Notably, the country has experienced a statistically significant decrease in rainfall during the wet season since 1960, alongside an average surface temperature increase of approximately 1°C during the same period (World Bank, 2013). These climatic shifts have resulted in heightened variability in rainfall patterns, particularly during the rainy season. Presently, precipitation occurs in a more erratic and concentrated manner, leading to droughts, severe floods and the destruction of agricultural harvests. Climate change is also contributing to soil salinization, reductions in underground water levels and river flows, ocean acidification, biodiversity loss, rising sea levels and coastal erosion (DEEC, 2022; ANACIM et al. 2013).

The cumulative impacts of climate change pose a significant threat to food security at the national level in Senegal. These effects manifest in various ways, including a reduction in agricultural productivity, increased uncertainty in seasonal patterns, more frequent and severe agricultural droughts, and the depletion of critical resources such as pasture, water, and fish stocks (CIAT & BFS/USAID, 2016). These effects jeopardise livestock health and productivity, amplifying food and livelihood insecurity, particularly in the arid regions surrounding the Ferlo desert, where pastoral livelihoods predominate, and in the Groundnut Basin, which represents the country's most productive agricultural region (ANACIM et al., 2013).

Recent years have seen food price volatility emerge as a significant driver of food insecurity, particularly in urban areas. Additionally, escalating agricultural input prices have eroded the capacity of rural communities to engage in subsistence agriculture. For instance, during 2011, drought conditions in several parts of the country resulted in a 20% decrease in grain production and a 31% reduction in groundnut production, pushing approximately 800,000 people into food insecurity (SECNSA et al., 2021; Rigaud et al. 2021). Since then, the country has experienced above-average drought conditions in at least four years (OCHA, 2018, 2022).

The Senegalese coastal zone concentrates 60% of human settlements and economic activities, including fishing, tourism and gardening (Croitoru, Miranda, & Sarraf, 2019). Around 90% of industrial establishments are located in these regions, contributing to 68% of the country's GDP. Additionally, 70% of the vegetables consumed in the country are produced in the coastal area of Niayes (Croitoru, Miranda, & Sarraf, 2019). However, the effects of coastal degradation, including river flooding, storm surges, coastal erosion, and salinisation, have profound repercussions over the national economy. Significantly, along the coast, the dune strip known as the "Langue de Barbarie" is recognised as one of the most vulnerable areas in Africa to sea-level rise and beach erosion. Its exceptionally

low topographic profile exposes it to various factors, including ocean currents, tides, heightened frequency and intensity of storms, strong winds, and a deficiency of natural vegetation to stabilise the sandy soil (UN-Habitat, 2001).

Senegal presents several stark instances of maladaptation to the impacts of climate change, wherein human responses to floods have inadvertently exacerbated environmental conditions, leading to heightened vulnerabilities. A notable example of this is the artificial opening of the breach, an artificial river mouth, during the flooding of Saint Louis in 2003. This intervention was originally intended to facilitate the flow of water and protect the old city from flooding. While the protection of the old city was achieved, the initial 4-meter wide opening has since expanded to a width of 6 kilometres, resulting in a multitude of problems (Sy et al. 2015).

These problems include the destruction and resettlement of two entire fishing village, the salinization of the Senegal River and adjacent agricultural lands in Gandiol, the extinction of species in the river, alterations in morphological characteristics, and life-threatening risks for artisanal fishers (Sy et al., 2015). As a result of these developments, recent studies indicate that the fisheries sector in Saint Louis is the economic activity most profoundly impacted by and vulnerable to climate change, particularly affecting small-scale fisheries (Mbaye, et al., 2022).

What are the drivers of conflict in Senegal?

Senegal is located in the most Western part of the African continent and lies largely in the drylands of the Sahel, a region that in the past years has been heavily affected by armed conflict and political instability. In comparison to its neighbouring countries, Senegal is regarded as one of the most stable and peaceful countries in West Africa and is considered as a great example of a post-colonial transition to a stable multiparty democracy (ECOWAS, 2017).

Despite high levels of stability, Senegal has been marred by one of the longest-standing conflicts in Africa. In 1982, a separatist insurgency led by the Movement des Forces Democratique de la Casamance (MFDC) ignited an armed conflict in the southern region of Casamance (Madurga-Lopez, 2021). Since the early 2000s the conflict evolved into a low intensity war that became increasingly intertwined with illegal economies, mainly around illegal logging and timber trafficking (Madurga-Lopez 2021; Foucher 2019). After long peace negotiations, some factions of the MFDC signed peace agreements with the government, putting an end to decades of hostilities (Madurga-Lopez, 2021; CHD, 2023). The protracted conflict has had far-reaching consequences, including 5,000 deaths, more than 24,000 displaced people, a significant decline in agricultural production, the destruction of infrastructure and livelihood assets, a rise in poverty levels, and increased dependence on food and development assistance (Madurga-Lopez, 2021; Albuja et al. 2014; . This has translated into food insecurity, with the Casamance region of Ziguinchor registering the country's highest food insecurity rates at 40% (WFP, 2011). Additionally,

the region consistently records the lowest Food Consumption score across the country (Nebie,2021). Simultaneously, there is also a lack of opportunities for the youth with 32%, 55% and 54% that are not in the education system nor employed in Ziguinchor, Kolda and Sédihou respectively (ANSD and AFRISTAT. 2019).

Senegal is one of the few countries in the region where radical Islamic extremism is not a striking issue. However, the expansion of jihadist groups in neighbouring Mali has raised concerns over the potential spillover and threat of radicalisation (USAID, 2017; Madurga-Lopez et al. 2023). Some jihadist groups have successfully managed to recruit Senegalese men for their operations in Mali (Moniquet, 2013). Meanwhile, the current economic crisis and political instability leave unaddressed the root causes of radicalisation and recruitment (poverty, unemployment and sense of abandonment) in Senegal (Sambe et al. 2021, Sambe et al. 2016; Sambe et al. 2018).

In early 2023, the Senegalese national elections were marred by allegations and criminalisation of the opposition leader, sparking nationwide protests and riots, particularly in the capital, Dakar. In response, the government implemented nationwide bans on social media and cut mobile internet access to quell the unrest. Nevertheless, the conviction of Ousmane Sonkho, an opposition politician, only escalated the violence, leading to additional riots, blockades, and incidents.

Illegal drug trafficking has garnered significant attention since the mid-2000s, raising concerns about its potential to provide funding for jihadist organisations (Sandor 2016; Bird, 2021). In addition to this, various other illicit and criminal activities, such as livestock theft, general crime, banditry, smuggling networks, and illegal gold mining, have also seen an increase in prominence (Toupane, 2021).

Furthermore, land use conflicts between the government and the Lébou Community resulted in significant clashes and incidents in early 2023. Meanwhile, conflicts between farmers and herders over land use have been ongoing for many decades. While local institutions have traditionally managed these conflicts effectively, recent years have seen an alarming increase in the violence associated with farmer-herder conflicts. This escalation is linked to mounting pressures on land, agricultural resources, and pastoral incomes, making these conflicts an increasingly pressing issue in the country.

Case studies

Fieldwork was conducted in four communities across Senegal, including: 1) pastoral, agro-pastoral and farming communities in the drylands areas of Louga 2) farmer and agro-pastoral communities in Kaffrine, 3) fishing and farming communities from the islands on the coastal area of Casamance, and 4) displaced farming communities in tropical forests in Casamance, 5) displaced fishing communities in Saint Louis.

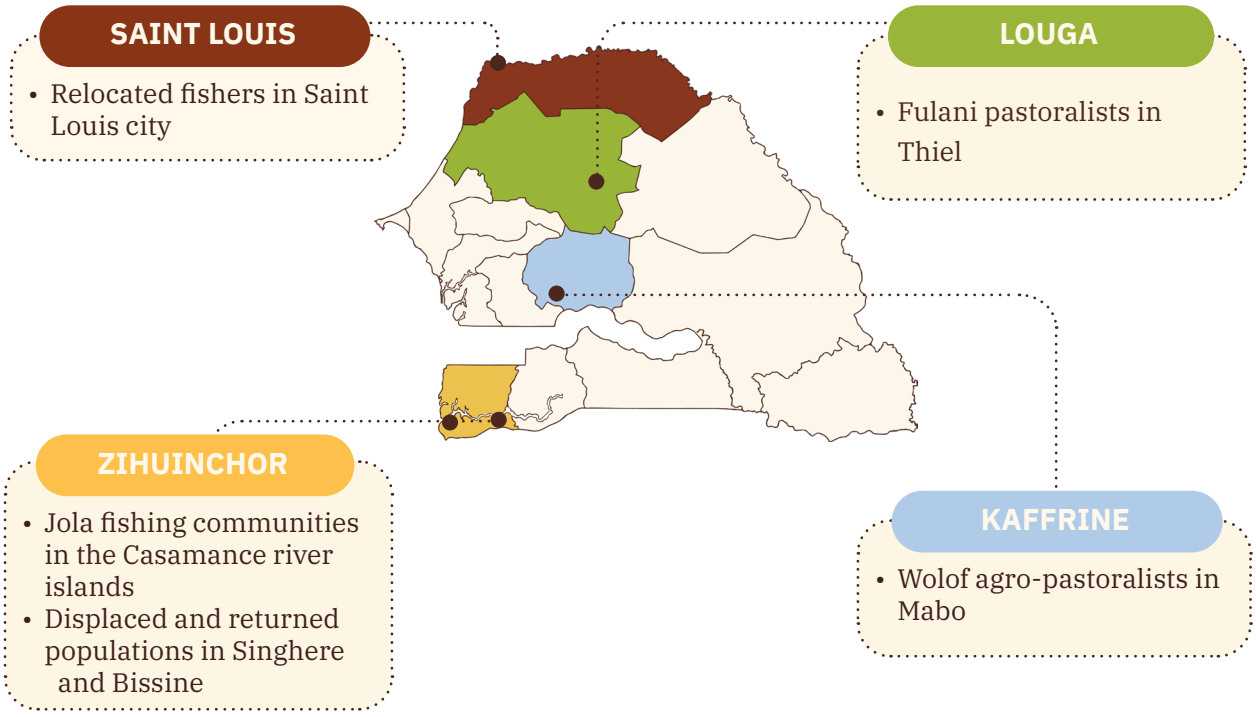

Figure 4. *Case Studies*

Pastoral and agro-pastoral communities Thiel, Louga

In the expansive Ferlo desert spanning across the northern regions of Senegal, the majority of Muslim Fulani communities primarily rely on livestock herding as their principal source of income. The maintenance of cattle, sheep, and goats also holds paramount importance in ensuring local food security. Notably, the practice of transhumance livestock herding, which entails seasonal mobility in pursuit of adequate pasture, continues to be the predominant production system employed by Fulani communities in this region.

For Senegalese pastoralists, the primary revenue stream emanates from the sale of animals. Over recent decades, there has been a gradual decline in both milk production and agriculture among these communities. Presently, milk production predominantly serves self-sufficiency purposes, with reduced commercial significance. Additionally, while off-farm sources of income, such as the sale of crafts, the collection of Arabic gum, and temporary labour, are prevalent within the Ferlo region, their contribution to overall livelihood strategies remains relatively marginal.

Rangelands have historically served as a critical resource for pastoralism in Senegal's Ferlo desert, representing a locally adapted strategy to manage the pronounced variability in precipitation. The brief rainy season, occurring between July and October, allows for localised herding activities in the vicinity of Thiel village, situated within the Louga Region—a small pastoralist community nestled in the heart of the Ferlo desert. During this rainy period, the confluence of higher pasture productivity and access to water through ponds or boreholes ensures the availability of ample feeding resources for cattle.

However, pastoral and water resources experience a substantial decline during the prolonged dry season, spanning from November to June. Consequently, numerous pastoralists in the Ferlo region embark on a southward migration towards more humid zones. In these areas, pasturelands and crop residues become the primary sources of sustenance for their livestock, while more perennial water resources are readily accessible. These transhumance movements entail the utilisation of established pastoralist migratory routes and temporary settlements within Senegal's agro-pastoral regions, particularly in the more fertile areas of the Groundnut Basin, such as the Kaffrine Region. Despite a recent trend toward semi-sedentarism among many Fulani pastoralists across the Louga region, largely driven by the increasing utilisation of boreholes, it is crucial to recognise that cattle herds remain highly mobile, reflecting the enduring reliance on traditional transhumance practices.

Historically, heightened engagement and interaction between farmers and agro-pastoral populations residing to the south of the Ferlo region have been associated with one of the primary conflict risks, namely, farmer-herder disputes. However, in recent times, a noteworthy development has taken place in certain parts of Ferlo, wherein resource management units have been established based on the distribution of boreholes. These resource management units are referred to as pastoral units. Situated at the centre of each pastoral unit is a vital watering point, around which revolves the area encompassed by a particular pastoral unit. The introduction of pastoral units has played a pivotal role in fostering collaborative management approaches to water and pasture resources within the Ferlo desert. This innovative framework has contributed to mitigating historical conflicts by providing a structured system for resource allocation and utilisation.

Agricultural communities in Mabo, Kaffrine

The Groundnut Basin, an extensive geographical region in Senegal, spans across the central and western areas of the country. It stretches from the western coastal area, south of Dakar, to the eastern and northern territories of Kaffrine. Within the Groundnut Basin, the population of Kaffrine, primarily consisting of individuals belonging to the Muslim Wolof ethnic group, shares similarities with the broader Basin population in terms of their heavy reliance on agriculture and livestock rearing for sustenance. Approximately 70% of the total population in the region derives their livelihood from these activities.

The agroecological zone located in Northern Kaffrine is characterised by favourable conditions for silvo-pastoralism. It features savannah-type grassland vegetation, with widespread shrubs and low trees growing in arid soil. The annual precipitation in this area typically ranges between 600 and 700 mm. This limited rainfall, coupled with pronounced seasonality, shapes the predominantly arid to semi-arid conditions in the area. Temporary ponds, replenished by rainwater, serve as critical water sources for livestock and, to a lesser extent, for irrigation purposes. However, it is important to note that these ponds often dry up during the dry season.

Economic activities in the region primarily revolve around agriculture, livestock rearing, forestry, and crafts. Nonetheless, the region has been grappling with declining crop productivity over the past few decades, attributable to soil degradation, reduced rainfall, and shifting seasonal patterns. Rain-fed agriculture is the prevailing farming method, rendering livelihoods highly dependent on stable climatic conditions. Despite concerted efforts by multiple national and international organisations to promote climate-resilient agricultural practices, food insecurity remains pervasive. Soil fertility has diminished significantly after years of reliance on chemical agricultural inputs, and crop production falls short of meeting the dietary needs of families throughout the year. Consequently, families are compelled to purchase food to bridge the production deficit, leading to the harvesting and sale of forest products. This practice not only exacerbates resource degradation but also perpetuates the cycle of food insecurity in the region.

Fishing communities in the Casamance River islands, Casamance

The Jola are an ethnic group that mostly inhabit the Lower Casamance region in Senegal. Their main dialect, the Jola language, is spoken by nearly half a million people in Senegal and neighbouring countries. Jola populations in the Casamance river are spread across 21 river islands, although only members from the estuarine islands of Carabane, Diogué and Niomoune were represented in this study. This region, characterised by its proximity to the Atlantic Ocean, experiences a maritime tropical climate, marked by high humidity levels and moderate temperatures. Annual precipitation typically ranges from 1,000 to 1,500 mm, with a pronounced wet season occurring from June to October. This significant rainfall, coupled with tidal influences from the ocean, gives rise to an intricate network of mangrove swamps and estuarine ecosystems, rich in biodiversity. The region's vegetation primarily comprises mangrove forests, salt marshes, and coastal woodlands. These ecological features provide critical habitats for various species of marine and avian fauna, making the area ecologically significant.

The Jola ethnic group in Senegal is recognised for their absence of conventional social and political stratification structures. However, specific Jola communities, such as those residing in the Casamance islands, do exhibit centralised authority in the form of a monarch, either a King or Queen. The historical underpinning of egalitarian principles within Jola societies has facilitated the evolution of political systems predicated on collective consciousness. This enduring trait is palpable today in the form of heightened social capital and a notable collaborative capacity observed among the island's inhabitants. Furthermore, it is noteworthy that the Jola communities commonly engage in the practice of sharing land among neighbours, devoid of formal leases, instead guided by the pragmatic imperative of necessity. Moreover, the Casamance islands are characterised by a thriving system of barter and trade in both goods and services, underscoring the socio-economic interconnectedness. A shared cultural heritage endures, with island residents participating in these traditions as a unified community.

The economic landscape of the Jola community residing along the Casamance River predominantly revolves around two primary sectors: fishing and wet rice cultivation. However, it's worth noting that the cultivation of wet rice primarily serves household consumption purposes. Additionally, this community engages in a spectrum of supplementary activities, including the extraction of oysters, typically found in the intricate root systems of mangroves along the river's coastal periphery. Furthermore, agriculture extends to the cultivation of yams, sweet potatoes, watermelon, and assorted fruits.

During the 1990s, the protracted Casamance conflict in Senegal had profound and enduring effects on the Jola fishing communities residing in the region. The conflict's disruptive influence extended across various dimensions, significantly impacting both the socio-economic and cultural fabric of these communities. First and foremost, the conflict disrupted the traditional rhythms of life for the Jola fishing communities. Pervasive insecurity, sporadic violence, and the presence of armed groups created an atmosphere of fear and uncertainty, making it increasingly challenging for these communities to engage in their primary economic activity, fishing. The conflict-induced instability led to a decline in fishing operations. The conflict also forced many community members to flee their homes, leading to displacement and the fragmentation of tight-knit communities.

Resettled fisher communities in Saint Louis city, Saint Louis

The Saint Louis region experiences an arid climate that is often affected by sandstorms originating from the Mauritanian deserts, especially during the dry season. Spanning across the northern border of Senegal with Mauretania and the Louga region, the majority of inhabitants in Saint Louis belong to the ethnic groups Pulaar and Wolof. These mostly Muslim communities primarily rely on agriculture and livestock farming as their main source of income. Much of the country's cereal production comes from this region, while sugar cane, tomatoes, onions and rice are also cultivated (ANSD, 2011).

The capital of the region, also called Saint Louis, is located on the northern coastal stretch of Senegal, at the border with Mauretania, near the mouth of the Senegal river. Many individuals engaged in the fishing industry in Saint Louis reside on a narrow stretch of land known as the "Langue de Barbarie," which is one of the largest and most renowned centers for artisanal fishing in Senegal. The Langue de Barbarie is home to four Wolof communities: Gokhou Mbathie, Santhiaba, Guet Ndar, and Hydrobase, where the primary language spoken is Wolof. The case study conducted for this research occurred in Santhiaba and Diougob, a resettlement site populated by people who have been displaced after the 2018 coastal flooding of "Langue de Barbarie".

The primary source of income for the fisherfolk in Saint Louis is derived from fishing, fish sales, and fish processing. Although households in "Langue de Barbarie" often raise livestock like goats and sheep for their own consumption, the availability of fish

is of utmost importance in ensuring local food security. While young boys and men are engaged in fishing, women are typically responsible for selling and processing the fish.

Life on "Langue de Barbarie" is intricately linked with water and fish, as the community is uniquely situated between the Senegal River and the Atlantic Ocean. The living conditions on this narrow island, which is only 300 metres wide, differ significantly from the rest of the city. Despite the dense population, residents share the limited space with livestock, fishing equipment, and traditional fishing boats known as pirogues. The fishing season typically spans from November to July, with the peak period being from March to May. During the rainy season, from July to October, fishing activities are reduced as fish become scarcer.

Explorative case study: Resettled farming communities to Bissine, Casamance

Within the Casamance region, in the Adeane commune located in the Eastern part of the Ziguinchor Region, communities suffered the highest rate of forced displacement during the Casamance conflict, as compared to the rest of the country, and were largely affected during the 1990s. The community of Singhere consists of three villages, namely, Singhere Bainouk, inhabited mostly by the Bainouk people; Singhere Diola, predominantly Jola peoples; and finally Singhere Escale, populated by Jola and Mandengue ethnic groups. Singhere Escale is one of the most impacted villages of the area, due to constant encounters with rebel groups throughout the conflict.

The site of Bissine is located just on the other end of a large road leading from Singhere. Bissine village consists of two neighbourhoods, namely Bissine Albondy and Bissine Bainouk. Bissine Albondy hosts a diversity of ethnic groups, including Jola, Peule, Mandengue, Wolof, Majack and Balainde. Bissine Bainouk hosts mainly people from the Bainouk ethnic group. Bissine is located at the border of the Bissine forest, which is classified as a national forest. People in this village were forcefully displaced by rebel groups over 30 years ago, and have only recently started to return. During 1992 and 1993, basically all of the population in Bissine Albondy and Bissine Bainouk left the town as a reaction to violent intrusions by combatants. The majority of Bissine's population went to find refuge in neighbouring Guinea Bissau. It was until 2017 that the organisation of a committee for returnees, supported by local NGOs, began reclaiming back land and supporting people to return. As of today, 400 people have come back to Bissine Albondy and many more are still expected to return. The attractiveness of the region by its former inhabitants is due to the abundance of resources and soil fertility for self-sufficiency that the area offers, even though the village lies far away from larger cities and access to markets. The villagers report that, before the conflict in Casamance, self-sufficiency was easily achieved and revenues from occasional tourism were also common.

Before the conflict, villagers of Singhere farmed corn, rice, groundnut, and beans; and were making sufficient revenues from the sale of these crops. Currently, people in the

village primarily grow watermelon, rice, groundnut, and corn, which can only be grown to cover their own household consumption, as productivity is low. Cultivation of watermelon has been increasingly popular through the past years, as the crop is easily sold in markets and considered highly profitable. However, due to increased out of season rainfall, crops are increasingly susceptible to rotting before harvesting. In Bissine Albondy, the most common crops are rice, cashew, groundnut, millet. However, the production has shrunk since people came back to their homes. Community members are now unable to produce sufficient rice to cover household consumption, forcing them to acquire additional produce at markets. Overall, farmers are facing difficulties with the cultivation of crops due to pests and insects, expensive grain prices and yields affected by rainfall variability.

This case study was conducted as part of an explorative site visit conducted by CGIAR Climate Security and in collaboration with Humanity & Inclusion. In these communities, the methodology was restricted to semi-structured interviews only. Therefore, this case study will not be discussed in the subsequent sections, but taken into consideration for drawing recommendations and conclusions for climate security in Senegal.

Photo: *Hands / V. Meadu*

A PARTICIPATORY APPRAISAL OF CLIMATE-RELATED SECURITY RISKS AND ADAPTIVE CAPACITIES

HOW ARE PEOPLE AFFECTED BY CLIMATE CHANGE?

In the context of climate change, the discernible impacts on various facets of society, including livelihoods, food and water security, public health, the provision of ecosystem services, infrastructure integrity, and societal dynamics, can be attributed to specific, contingent vulnerabilities. These vulnerabilities, in turn, are rooted in a complex interplay of socioeconomic, political, ethnic, gender-related, and environmental factors. The ensuing consequences are manifested heterogeneously across regions, communities, households, and individuals. This section serves to provide a concise overview of community-level perceptions pertaining to climate change and its repercussions on livelihoods and human security.

In spite of the wide-ranging climatic diversity observed across the assessment sites, the primary economic activity sustaining the livelihoods of the three communities participating in this study is small-scale food production. This activity holds paramount significance in upholding their traditional ways of life and overall well-being. Communities in Louga exhibit a semi-nomadic pastoralist lifestyle, complemented by farming practices aided by increased access to water resources stemming from infrastructure development. Meanwhile, populations in Kaffrine and the broader Groundnut Basin primarily engage in farming, cultivating peanuts for export and crops such as corn, millet, and sorghum for both subsistence and small-scale cash crops. Notably, the prevalence of agro-pastoralism is observed, underscoring the perceived productivity of livestock-crop systems.

Conversely, residents residing along the Ziguinchor river estuary and the Casamance Pacific coast rely on open-sea fishing, small-scale aquaculture, and the collection of seafood from coastal mangrove ecosystems. In addition to their aquatic endeavours, these communities partake in subsistence agriculture, predominantly centred around rice cultivation, alongside the maintenance of vegetable gardens. Across all these diverse contexts, local markets play a pivotal role as the primary source of food provisioning. In summary, the livelihood strategies of individuals within all assessed areas are intricately tied to predictable seasonal conditions, the availability of land and natural resources, and the consistent flow of ecosystem services derived from forests, seas, or grasslands.

People in the three assessment sites also rely on numerous commercial activities which are not influenced by seasonal change, and are to different degrees dependent on the availability of natural resources. These activities are discussed as income strategies which are commonly adopted once agricultural-based livelihoods are not sufficient for sustenance and revenue. Numerous jobs in Ziguinchor, for example, rely on eco-tourism. Young people in particular commonly become temporary labourers, often migrating to cities and seeking employment in construction and the service industry. Despite common adoption of non-agricultural livelihoods, members from all communities expressed that high degrees of illiteracy, mainly in older people, a low availability of alternative

employment opportunities, and the lack of social protection schemes that support people in the face of hardship are among the main constraints to adaptive capacities.

The study participants engaged in discussions that revolved around a multitude of factors linking their daily lives to the escalating climate variability and extreme events. Over the period spanning from 2002 to 2019, the assessment sites recurrently experienced a series of floods and droughts, occurring almost annually. These climatic phenomena had profound ramifications. The agricultural landscape has undergone significant transformations with crop productivity witnessing a marked decline since the onset of the new millennium. This decline is closely linked to the depletion of essential nutrients from the soils. In the pastoral regions of the Ferlo desert, shifts in precipitation patterns compelled communities to relinquish the cultivation of sorghum, a staple crop. Furthermore, adaptations to millet and groundnut varieties have become imperative in the Kaffrine region, owing to a substantial decline in agricultural yields. The root cause of this decline is primarily attributed to alterations in precipitation patterns.

Concurrently, pastoralists have grappled with a reduction in available pasture, largely attributable to the increasingly arid soil conditions. Consequently, pastoralists have been compelled to purchase fodder as a supplemental source of animal feed. Moreover, the former cultivation of subsistence crops, such as beans (niebe), for human consumption has become unviable due to these changing conditions. This has resulted in a limitation of crop production to varieties intended exclusively for animal consumption. These observations underscore the profound and multifaceted impacts of climate variability and extreme events on the livelihoods and agricultural practices of the studied communities.

Climate-induced effects have exerted significant pressures on rural livelihoods, prompting a noteworthy portion of the study participants to actively explore alternative means of sustaining an income. A range of adaptive measures have been undertaken in response to these challenges. One key adaptation strategy has been the adoption of climate-resilient seed varieties, characterised by shorter growing cycles and enhanced resistance to adverse precipitation patterns and elevated temperatures. This shift in seed selection aligns with the need to better align agricultural practices with the changing climate conditions.

Furthermore, a discernible trend among younger members of these communities involves migration to larger urban centres or foreign countries, notably European nations. This migration pattern reflects a desire to seek economic opportunities in more urbanised and economically developed areas. At the same time, local populations are witnessing significant internal migration trends across rural regions, often leading to social disruptions when migrating onto the lands of other communities and resulting in the amalgamation of different ethnic groups. This dynamic migration pattern has multifaceted implications for social cohesion and intercommunity relations.

Pastoral and agro-pastoral livelihoods in Thiel, Louga

In the arid regions of central and north-western Senegal, where vegetation productivity is inherently limited, mobile pastoralism stands as the predominant livelihood strategy among the local communities. Historically, these areas have been particularly susceptible to recurrent dry spells (ANACIM et al, 2013). Nevertheless, both male and female pastoralists in Thiel perceive climate change primarily through unpredictable seasonal patterns and year-to-year fluctuations. The altering rain patterns have emerged as the principal catalyst for subsequent climatic adversities, notably the emergence of extended and more severe droughts, a decline in surface water availability, and heightened moisture stress, resulting in agricultural droughts. Additionally, there has been a notable increase in the frequency of sudden heavy rains, leading to destructive floods. These climate-induced effects collectively pose significant threats to pastoral-oriented livelihood strategies.

Testimony from a male pastoralist during FGD in Thiel

"Before, livestock would sometimes get stuck in the soil during rainy season due to the wetness. People would have to pull them out very frequently. Today this never happens. Also, in the forest, temporal ponds used for water are no longer available. One can never find these ponds anymore."

Community members, encompassing both male and female participants, have collectively identified one of the most direct repercussions of erratic rainfall as a notable increase in livestock mortality rates. These changes in rainfall patterns exert a profound influence on both the quantity and quality of available water resources. Prolonged and recurrent droughts exacerbate the challenge by hindering the replenishment of groundwater, which is vital for livestock hydration and small-scale irrigation practices. The extended and more severe dry spells that have become more prevalent in recent times have led to reduced rates of livestock conception, consequently resulting in below-average calving rates. Pastoralists in Thiel have reported that sustaining their animals now necessitates the purchase of fodder, a development that has substantially driven up fodder prices in recent years. Furthermore, erratic rainfall patterns render livestock more susceptible to diseases, thereby causing the animals that reach the market to frequently exhibit signs of weakness or illness, ultimately reducing their economic value. These cumulative effects highlight the substantial challenges faced by pastoralists in Thiel, stemming from the changing climate and its impact on their livestock-dependent livelihoods.

Seasonal calendar of Fulani pastoralists in the Thiel community

Study participants were asked to describe livelihood activities and associated risks based on typical yearly seasonal patterns, accounting for climate, health, food security, and conflict-related risks.

The Ferlo Desert, situated in northern Senegal, is a unique and ecologically diverse region characterised by a semi-arid climate and distinctive ecological conditions. This vast expanse experiences a pronounced dry season, with annual rainfall averaging between 300 to 600 millimetres, primarily occurring from July to September. Despite its arid reputation, the Ferlo Desert showcases a remarkable adaptation of flora and fauna to these challenging conditions. Thorny acacia trees and drought-resistant shrubs dot the landscape, while hardy grasses provide sustenance for the region's wildlife. Furthermore, the pastoral Fulani people have thrived in this harsh environment, relying on nomadic herding of cattle, goats, and sheep, demonstrating the resilience of both nature and humanity in the face of arid challenges. However, the Ferlo's delicate ecosystem faces growing threats from climate change, overgrazing, and deforestation, highlighting the need for sustainable conservation efforts to protect its unique biodiversity and support local livelihoods.

Season	Cheddu	Chetsele	Ndungu	Dabounde
Months	January - April	May - June	June/July - October	October - December
Weather	Dry season	Last stretch of dry season	Rainy season	Post-rainy season
Climate conditions	• Lack of rains • Dry and warm soil • Warm wind and lots of dust • Low pasture availability	• High temperatures • West winds • Natural indicators for the coming of rains (trees and flowers blooming, bird immigration)	• Constant rains • Warm and humid weather at the beginning • Transition to colder temperatures • Availability of pasture	• Very windy • Very cold winds from east to west • Transition to drier conditions (common dry-spells)
Livelihoods	• Out migration to southern regions • Following livestock in search of pasture • Trading • Selling of animals after fattening • Charcoal production • Hunting and gathering (commonly in the south)	• Pastoralists return to the North • Low livestock prices • Land preparation for farming • Plot extension (commonly into migratory corridors) • Charcoal production	• Herders are breeding the cows • Livestock can pasture freely • Planting crops (groundnuts, millet, beans and maize) • Caring for crops • People support each other for farming labour and inputs (reciprocity) • Recruitment of farm-labour • Youth immigration for temporary employment	• Crop harvest • Herder immigration from northern regions • Livestock can pasture freely • Youth immigration for temporary employment
Climate risks	Dry season risks: • Drought • Low access to water • Livestock death • Failing of crops due to drought • Forest fires		Rainy season risks: • Short periods of drought (longer gaps between rains) • Non-predictable onset of rains • Excessive rain and floods • Loss of seedlings • Lack of land for pasture • Livestock disease	
Security risks	Dry season risks: • Food insecurity • Lack of savings to cover expenses • People experience fatigue • Conflicts over access to water • Livestock theft • Out-migration and associated risks		Rainy season risks: • Farmer-herder conflicts • Land conflicts • Farmers occupy migration corridors • Livestock theft • Difficult transportation and low access to markets • Food insecurity • Human diseases	

Figure 5. *Seasonal calendar.*

Adaptive capacities and responses to climate change in Thiel

Unpredictable precipitation during rainy seasons affects the availability of pasture, thereby negatively impacting livestock productivity, milk production and the spreading of disease among cattle, ultimately reducing the incomes and food security of pastoralist households. People have responded to these impacts through different means and in accordance to household and individual degrees of coping capacities. Responses include the storage of livestock feed during periods when savings are available, changes in water management, diversification of income activities and changes in the composition of livestock herds, such as a prominent shift towards goat keeping. The loss of incomes from pastoral livelihoods is also thought to be related to increasing migration, both within and beyond Senegal´s borders, in the search for alternative livelihoods. Although pastoral livelihoods have in general developed to be highly adaptive in the face of uncertain ecological and climatic conditions, all of these responses are perceived to be greatly reliant on individual households´ wealth and assets, employment capabilities, social capital, and access to external support in the form of government aid and infrastructure development, weather forecasting and social protection.

Testimony from a male pastoralist during FGD in Thiel

"In the past, people migrated to Thiel, thinking that there would be a lot of pasture and food for cattle. But, since then, people are forced to leave this place because of a lack of pasture."

Community members express a prevailing perception of inadequate government support to bolster the adaptive capabilities of households. This deficiency in public intervention amplifies the vulnerability of households, compelling individuals to grapple with difficult decisions regarding asset management. For instance, initiatives aimed at environmental conservation and agricultural extension create challenges for herders who must navigate extensive distances, often around areas designated for conservation or farming.

Despite notable strides in delineating herding routes and farming territories, fostering the development of markets and enhancing access, and improving veterinary services, pastoral communities continue to perceive a distinct government bias in favour of safeguarding the livelihoods of farmers and promoting a transition towards non-nomadic livestock rearing practices. However, the notion of sedentary pastoral livelihoods is deemed infeasible due to the inhospitable ecological conditions prevalent in the Sahel region. These conditions are characterised by inadequate vegetation to sustain animals year-round, rendering mobility an essential component of pastoral livelihoods. This perception underscores the critical need for a more balanced and equitable approach to government support and intervention, one that takes into account the unique challenges and vulnerabilities faced by pastoral communities within the region.

Within the municipality of Thiel, local communities have diversified their income streams by tapping into natural resources, notably forest resources within their vicinity. A common income-generating activity is the production of charcoal, a year-round endeavour. However, charcoal production rates have notably declined due to the depletion of forest resources, which are no longer as abundant as in the past. Despite this, trees continue to be harvested for charcoal production, albeit in smaller quantities compared to previous levels. During the dry season, economic activities primarily revolve around the collection of resources from the natural environment, such as wild fruits, to supplement household incomes.

Testimony from a female pastoralist during FGD in Thiel

"The effects of climate change are not the same for all people as they do not have the same access to financial resources."

Of particular significance among women in this community are the associations formed in response to a range of environmental, social, political, and economic threats. One noteworthy example of such groups is the milk transformation association. For example, women in the community have adopted a distinct approach to cope with the fluctuations in agricultural incomes. They engage in the formation of informal savings and credit groups, locally referred to as "tontine", to foster more secure income streams for their households and enhance access to credit.

The milking of cows and the sale of milk predominantly fall under the purview of women within this community. By processing milk into various products, such as yoghurt, there is a reduction in product spoilage, thus extending its shelf life. However, the availability of milk hinges on the quality of nutrients the animals receive from grazing. In times of insufficient rainfall, livestock productivity diminishes, thereby affecting the livelihoods of women in particular. Furthermore, capacities for mil processing were described as severely limited within the community. Women bear a direct burden during periods of inadequate rainfall because, traditionally, men assume the role of household providers. When they are unable to fulfil this role due to adverse weather conditions, women are compelled to step in to bridge the gap, further highlighting the gendered dynamics at play within the community.

Testimony from a male pastoralist during FGD in Thiel

"Women milk out a lot of product but there is no infrastructure to manage or process the milk. People instead chose not to milk as much as possible, because it would be lost. They then wait until market day to milk it."

Agro-pastoral livelihoods in Mabo, Kaffrine

The agroecological zone situated in Northern Kaffrine boasts favourable conditions for agricultural and livestock activities, constituting the cornerstone of the region's economy. The primary economic pursuits in this locale encompass farming, cattle herding, and forestry. Local residents have identified three principal climate-related threats that cast a shadow over these activities, namely, strong winds, droughts, and floods. These climatic hazards exert a direct and detrimental influence on the livelihoods of the local population, manifesting as crop and livestock losses and a reduction in forest productivity.

Elevated temperatures, salinization of soils, extended arid periods, and more frequent inundations further exacerbate the situation, adversely impacting soil fertility, elevating soil erosion rates, and diminishing the availability of surface water. These cumulative effects collectively contribute to a reduction in agricultural output. Study participants have reported tangible alterations in the productivity of key crops, including millet, groundnuts, rice, fruits, and palm trees. Furthermore, changes in the size and quality of these crops have also been documented, underscoring the complex interplay of climatic factors on the agricultural landscape of Northern Kaffrine.

In addition to climate-related factors, various land use practices further exacerbate the decline in agricultural yields, thereby intensifying the challenges faced in sustaining farming as a secure means of livelihood. These contributing factors encompass escalating deforestation, which is closely linked to soil erosion and the deterioration of land quality, as well as issues such as overpopulation and the rising costs of agricultural inputs. These complex interactions between climatic and land-use factors underscore the imperative need for policy interventions aimed at bolstering the resilience of local communities in Northern Kaffrine and safeguarding their agricultural and economic well-being.

Testimony from a male pastoralist during FGD in Thiel

"Before I wouldn´t use any products, and it would be good in those times. This means that the soil was very productive. If you compare the amount of harvest that my father would get in the same amount of land, it was a lot more than what I get today. Before, if you planted 5 kilos of peanut, you would have 100 kilos after harvest. But if you plant today the same amount of seeds you will have way less, like 30 kilos. In those days, there were trees and the soil was dark. The soil was like this [points to the dark brown table], now it is very clear and dry."

The participants engaged in farming activities did not report experiencing climate variability in the form of either shorter or longer rainy seasons. Instead, they perceived it as unpredictable patterns of precipitation. For instance, despite the prevailing drought conditions observed throughout Senegal in both 2020 and 2021, farmers residing in the

Mabo region were adversely affected by the untimely onset of heavy rains in May, which led to the destruction of recently planted crops.

It is noteworthy that the majority of farmers in Mabo routinely incur debt on an annual basis to cover the costs associated with the upcoming planting season. This debt is subsequently repaid directly from the proceeds of the harvest or in cash upon its sale. Within this context, the increasing risk of crop losses stands out as one of the most pressing challenges faced by the local population. An illustrative example of this challenge is that a significant proportion of the study's participants reported experiencing difficulties in repaying their debts after the harvest at least once during the past three years. This situation often compels individuals to adopt short-term and suboptimal asset management strategies, including selling off land or livestock. Furthermore, it is crucial to emphasise that the vulnerability to such adverse climatic events is compounded by the limited access to crop insurance within the community. This underscores the need for policy interventions aimed at addressing these issues and enhancing the resilience of local farmers to climate-related risks.

Early in the rainy season, when many costs arise for purchasing food, paying school costs, and caring for illnesses, is a particularly difficult time. Members of the community are increasingly at risk of illnesses like malaria and tiredness brought on by strenuous manual labour and inadequate nutrition. Overall, the community perceives food insecurity as a risk factor that is rising. Insufficient food production and food insecurity have been linked to the co-occurrence of irregular rainfall, droughts, floods, land degradation, poor pasture and fodder supply, and rising input and food prices.

Poorer households—those with the fewest acres of land, cows, goats, or other productive assets—are constantly at risk of food insecurity, but there are some seasonal windows when recovery is possible. Participants noted that after crop harvesting and the start of the animal breeding season, the months of June through September, and then briefly in December, are times of abundance. However, the months of January through April and again from September through November are marked by a lack of financial resources and a shortage of food supplies, both of which contribute to food insecurity. People frequently rely on other community members when they are through times of food insecurity and financial hardship. Overall, communities have identified irregular rainfall patterns, which may include frequent breaks or unpredictable shorter or longer periods of precipitation, a shift from dense forests with trees and wild animals to the disappearance of both, and a general decline in crop productivity as the biggest challenges related to climate hazards and vulnerability.

Testimony from a community member during FGD in Mabo

"Before we had the forest with trees. But from 1992, that is when we realised the lack of the rains. In the past there were many trees and animals, you wouldn't dare walk alone in the forest. Now the trees are gone, along with the animals."

Seasonal calendar of Mabo community

Study participants were asked to describe livelihood activities and associated risks based on typical yearly seasonal patterns, accounting for climate, health, food security, and conflict-related risks.

The Groundnut Basin in Senegal covers a large swathe of the central and western regions of the country. It extends from the western coast, south of Dakar, to the eastern and northern regions of Kaffrine. Savannah-type grassland vegetation is common, together with widespread shrubs and low trees in very dry soil. Temporary ponds fed by rainwater are commonly used for irrigation, plus there are water holes for livestock, although both of these commonly dry up in the dry season.

Season	Nord	Thiebe	Nawett	Nawett
Months	February - May	May - June	June - October	October - February
Weather	Dry season	Pre-rainy season	Rainy season	Post-rainy season
Climate conditions	• Lack of rains • Dry and warm soil • Warm temperatures • Strong winds • Low pasture availability • High-levels of soil salinisation • Underground water hard to access	• High temperatures • West winds • Natural indicators for the coming of rains (trees and flowers blooming, bird immigration) • Underground water easily accessible	• Constant rains • Warm and humid weather • Availability of pasture	• Cold temperatures • Light wind • Rare and sporadic rains • Transition to drier conditions • Increasing soil salinisation
Livelihoods	• Farmers take a rest and focus on livestock. • Youth out migration for temporary employment • Presence of herders following livestock in search of pasture • Livestock can pasture freely • Charcoal production • Hunting and gathering (commonly in the south)	• Land preparation for farming • Plot extension (commonly into migratory corridors) • Access to financial services • Production of organic fertiliser and buying of chemical fertiliser • Trading and selling of animals • Low livestock prices • Charcoal production	• Planting crops (groundnuts, millet, beans and maize) • Caring for crops • Recruitment of farm-labour • Herders are breeding livestock • Youth immigration for temporary employment • Outsider herders return to the North	• Crop harvest and access to markets • Plenty of food and lower prices • Celebrations commonly take place • Savings for next season expenses are planned • Higher expenses like school fees • Herder immigration from northern regions • Livestock can pasture freely
Climate risks	Dry season risks: • Drought • Low access to water • Livestock death • Failing of crops due to drought • Forest fires		Rainy season risks: • Short periods of drought (longer gaps between rains) • Early onset of rains • Excessive rain and floods • Loss of seedlings • High prices of agricultural inputs • Lack of land for pasture • Livestock disease	
Security risks	Dry season risks: • Out-migration and associated risks • Livestock theft • Farmer-herder conflicts • Food insecurity • Conflicts over access to water		Rainy season risks: • Lack of savings to cover expenses • Early selling of harvest (lower prices) • Land conflicts (more common within households) • Food insecurity • Farmers occupy migration corridors • Farmer-herder conflicts • People experience fatigue • Difficult transportation and low access to markets • Human diseases	

Figure 6. *Seasonal calendar.*

Adaptive capacities and responses to climate change in Mabo

One of the most prevalent adaptation strategies employed in response to changing social and ecological conditions is migration. This migration predominantly occurs during the dry season when younger members of the communities find themselves unemployed and in search of income-generating opportunities. These young migrants often venture into urban areas where they secure jobs that demand substantial physical labour and stamina, albeit with meagre compensation. Consequently, individuals who have previously migrated reported returning with minimal savings.

During the rainy season, it is customary for these migrants to return to their communities to provide support in crop farming. This return is particularly crucial during the lean season when additional savings and labour are essential, as many households have depleted their food reserves, and strenuous agricultural work is imperative. While some among the elderly population attribute youth migration to poor governance in the regions, emphasising the presence of ample natural resources, including land, sand, forests, and more, others highlight the positive dimensions of migration. Those who have migrated to other areas often acquire knowledge about improved farming practices, which they subsequently apply upon their return to their communities, thereby contributing to the enhancement of agricultural practices.

Testimony from a farmer woman during FGD in Thiel

"Now with climate change, farmers experience difficulties in farming to sustain their income and migration became necessary for having an income."

In response to the impacts of climate change and increased pastoral mobility in the region, more stringent regulations have been implemented across Kaffrine to govern pastoral movements during harvesting seasons. This regulation, effective from October 15th to January 15th, prohibits pastoralists from entering farmland in the area during this period. This strategy has been particularly favourable for community members in Mabo, the majority of whom engage in crop farming. Consequently, even in the face of fluctuating rain patterns, farmers have fewer concerns about potential crop damage resulting from the entry of pastoralists and their herds into crop fields.

In addition to these regulations, another strategy adopted by farmers involves securing loans to finance agricultural work. Community members have reported taking out loans to ensure they have sufficient inputs for agricultural activities, even if the previous year's harvest did not yield enough income and inventory. This necessity often compels individuals to sell their harvests in advance at lower prices, reflecting the challenges faced by farmers in maintaining their agricultural operations and livelihoods amidst climate-related uncertainties and changing conditions.

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Testimony from an elderly during FGD in Mabo

"We are not saying migration is a good thing. But that under the current problems, where we don´t have land or jobs. Then migration can be a solution. And I think this is the purpose of this gathering, to find solutions."

Testimony from a young community member during FGD in Mabo

"If we have something we can do as young people, we can stay in the country and this region. This is better than going outside. But if there is nothing to do, then going away is better. If you want to help young people, you have to help them find a job where they live."

Photo: *AICCRA*

Fishing livelihoods in Casamance

Jola fishing communities residing on the islands along the Casamance river are grappling with pronounced adverse climate-related impacts, manifesting in several ways. These climate-related challenges encompass coastal erosion, rising sea levels, land and water salinization, diminished precipitation, reduced fish catches, and intensified winds. Coastal erosion has historically plagued these communities, but since the 2000s, it has grown significantly more severe, surpassing the local capacities to counteract the encroaching sea. Particularly during the onset of the rainy season, there is a notable loss of sand, exacerbating coastal erosion.

Testimony from a young student during FGD in Caraban Islands

"There was a time at Diogué, just at the entrance, that a signal lamp was very far away from the village, just at the sea. It is clear today that the coastal erosion has taken over this lamp, and it has had to be moved, also taking over some villages. We now have very strong waves. I can say that, since I can remember, and I was born in 1993, this phenomenon has been going on. Since the year 2000, we realised that the sea would increase until coming into our houses. This is when the rise of the sea created flooding in our houses."

Local perceptions are also confirmed by previous studies. For instance, Sarr (2018) reports that the islands of Diogué and Carabane have experienced an estimated loss of over 10 hectares of arable land and built-up areas between 2006 and 2016. Study participants reported that coastal erosion in the Casamance river islands and Saint Louis has led to a series of detrimental effects, including:

- Loss of land: Coastal erosion has resulted in the significant loss of land, especially in the eastern part of the islands. This land loss has encroached upon inhabited areas, reducing available space for communities.
- Increased salinization: As the sea advances due to erosion, it progressively inundates the land. This has led to increased salinization of both soil and freshwater sources, making it challenging for agriculture and freshwater access.
- Destruction of infrastructure: Coastal erosion has damaged critical infrastructure, including public buildings such as schools, utilities, and houses, thereby disrupting the normal functioning of the affected communities.
- Loss of vegetation: Trees and vegetation along the coastline have been severely impacted by erosion, affecting the local ecosystem and diminishing natural barriers against further erosion.
- Loss of fishing resources: Erosion has also taken a toll on fishing communities, as fishing nets and gear are often damaged or lost. Reduced fish catches have further exacerbated economic challenges for these communities.
- Impact on neighbouring islands: The continuous erosion has also affected neighbouring islands, with shorelines retreating and contributing to similar challenges faced by those communities.

- Community displacement: In extreme cases, coastal erosion has forced communities to relocate, causing disruption and dislocation of livelihoods and social structures.

Overall, coastal erosion has brought about a range of interconnected challenges, affecting the environment, economy, and social fabric of Jola fishing communities. Moreover, infrastructure development has at times exacerbated this issue. For example, the construction of a local port in Carabane island has accelerated coastal erosion, particularly in the eastern part of the island, where the port and incoming vessels have altered the natural flow of water.

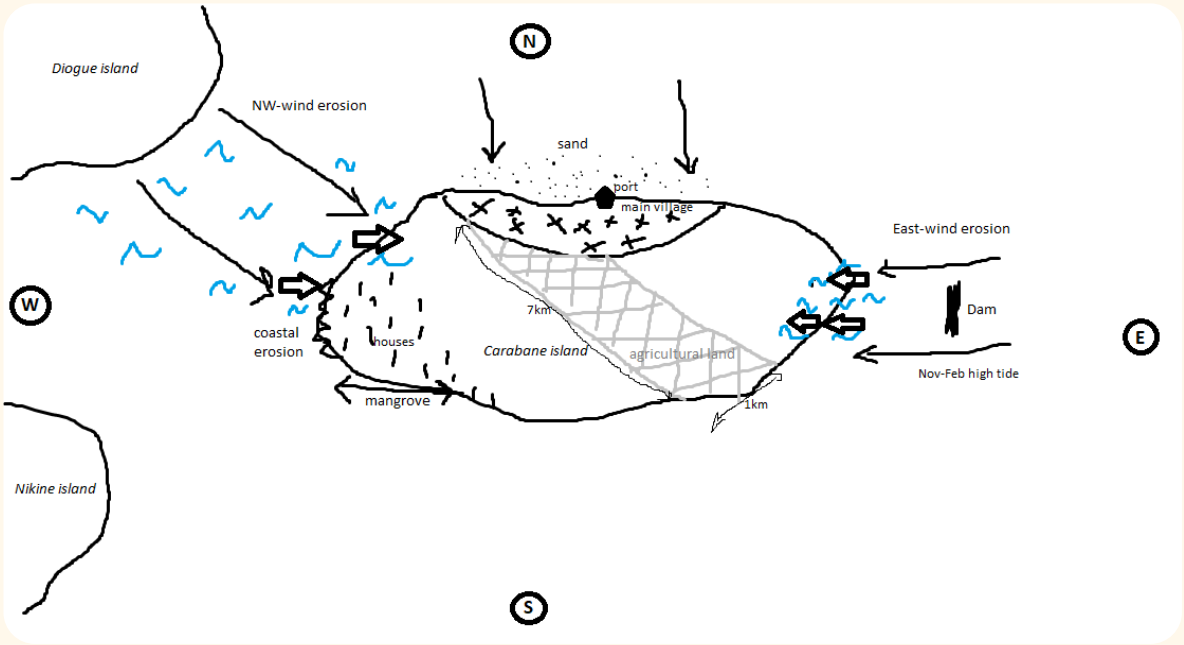

Figure 7. *Coastal erosion as perceived by community members.*

The irregularity and insufficiency of rainfall have exacerbated the issue of land salinization on the Casamance river islands. This problem is closely intertwined with deforestation, driven partly by the felling of trees for charcoal production but increasingly due to the effects of coastal erosion and saline intrusion. As tree cover has diminished, the natural windbreaks have disappeared, leading community members to report experiencing stronger winds, particularly compared to the period prior to the 2000s.

Testimony from a young man during FGD in Carabane Island

"Coastal erosion is something that dates back from the past. We can talk about it before and after. But there was a moment in which it got a lot worst. Often now, during the rainy season, coastal erosion accelerates. Floods have increased during heavy rains, and this water goes into the sea with a lot of sand."

Furthermore, fish stocks in the region have significantly dwindled over the past 15 years. Although fishing and farming constitute the primary economic activities on the islands, fishing has become progressively less productive due to declines in fish populations. This decline is attributed in part to the presence of large incoming boats, which cast expansive fishing nets and capture substantial quantities of fish. These boats often employ selective practices, discarding undesired parts of the catch. Coupled with unsustainable fishing practices by foreign fishers, this has considerably reduced the fishing success among community members.

In summary, the combined effects of climate-related factors, deforestation, and unsustainable fishing practices have led to a range of interconnected challenges for Jola communities along the Casamance river, impacting both the environment and local economic activities, particularly in the fishing sector.

Seasonal calendar of fishing community

Study participants were asked to describe livelihood activities and associated risks based on typical yearly seasonal patterns, accounting for climate, health, food security, and conflict-related risks.

The climate on Carabane and its surrounding islands is tropical, characterised by a cyclical pattern of dry and wet seasons, with an average annual precipitation of approximately 1200mm. These islands, situated only 2 metres above sea level, experience partial inundation during the rainy season. This phenomenon has compelled administrative buildings and residences to be relocated further inland to mitigate the impact of flooding. In addition to flooding, salinization of land and coastal erosion have emerged as the most pressing environmental challenges confronting these islands. These interconnected issues pose significant threats to both the environment and the livelihoods of the local communities.

The agricultural calendar in this context unfolds with land preparation procedures commencing in the month of June. Planting activities are then orchestrated at the onset of the rainy season, which falls within the period of July through September. The early days of August herald the inception of the first harvesting cycle, which in turn is succeeded by a second cycle of seed planting. It is imperative to recognise that two distinct harvesting cycles punctuate each rainy season. Conversely, the fishing enterprise assumes a continuous operational tempo, albeit with pronounced fluctuations in catch rates during the rainy season due to the heightened intensity of tides. It is essential to underscore that fishing remains the central economic activity underpinning the livelihoods of this community.

Season	Houle	Bouring	Hadjiane	Kahaouaguene
Months	January - March	April-June	July - September	October - December
Weather	Dry season	Pre-rainy season	Rainy season	Harvesting season
Climate conditions	• Windy • Strong waves • Water bed decreases • Increased salinity of water	• Extreme heat • Hot and dry winds	• Heavy and sporadic rains • Hot and humid weather • Rise of sea water	• Warm weather • No rains • High humidity • Windy conditions
Livelihoods	• Decreased water levels in wells • Kitchen gardening (vegetables) • Season migrations to main land • Temporary jobs on cash crop farms (palm tree plantations) • Active fish trading	• Fishing takes places regularly • Preparation of fields • Cattle grazing • Rice reserves exhausted, people are obliged to buy rice	• More fish near coast • Farmers prepare seeds and land • First harvest early august • Second planting • Heavy rains and storms dangerous for fishermen • Increased milk production	• Harvesting of rice and palm tree fruits • Commercial fishing • More free time and more cultural festivities to celebrate harvest end • Rains can continue until schools open, creating problems
Climate risks	Dry season risks: • Rise of sea enters farm fields (happens throughout the year) • Increased salinity • Reduced farming possibilities with salinisation of soils • Coastal erosion • Reduction in fish stock		Rainy season risks: • Strong winds and storms • Many diseases (e.g. malaria) • Flooding	
Security risks	Dry season risks: • Land-based conflicts • Food insecurity • Limited access to potable water		Rainy season risks: • Risks to fishermen • Destruction of property • Displacement	

Figure 8. *Seasonal calendar.*

Adaptive capacities and responses to climate change in the Casamance River Islands

The islanders have developed various strategies to adapt to changing environmental conditions related to lack of rainfall, smaller fish stocks, coastal erosion and salinisation. Adaptation strategies are found in agricultural practices, alternatives to fishing such as seasonal migrations, coastal management and local tourism.

In the context of rain-fed agriculture and limited arable land, community members have adapted their crop choices, primarily focusing on crops that can be grown within one or two cycles annually. Due to the scarcity of suitable land, farmers often resort to continuous cropping, planting the same crop year after year. This practice, while maximising land use, poses challenges to soil productivity as sustainable techniques like crop rotations are constrained by space limitations.

To maintain crop productivity, the community has implemented a bird monitoring system, especially for vulnerable seedlings, to deter birds from damaging crops. A similar monitoring approach is used to prevent livestock from harming early crops. Additionally, the community has consciously chosen to abstain from using chemical fertilisers due to concerns about potential side effects. Instead, they have traditionally employed locally produced natural fertilisers, including animal manure and leaves, for soil enrichment. However, the pressure to adopt chemical fertilisers is growing, even against the preferences of many households.

Coastal erosion has introduced new challenges related to agricultural land. Land parcels are typically family inheritances passed down through generations. Previously, when coastal erosion affected a farmer's land, they would seek access to a neighbour's land. Strong social relations within the community facilitated equitable land management. Additionally, water irrigation during the rainy season was a viable solution to boost productivity, but this practice has waned due to reduced rainfall. While agriculture once engaged a majority of the community, today, only around 10% of islanders continue farming. Farming activities are now largely confined to the short rainy season and kitchen gardening, primarily focused on vegetable cultivation and is mainly practised by women.

Fishing remains a central activity on the island, yet diminishing fish stocks and adverse weather conditions have prompted fishermen to seek alternative income sources. Fishing takes place year-round, with the rainy season being a particularly challenging period due to heavy winds and thunderstorms, making it unsafe for fishing. Fishermen adapt by saving during more productive seasons and utilising their savings when fishing is unviable. They also rely on daily weather forecasts to decide whether to venture into the sea. During the off-season, some fishermen find work on cash crop farms, harvesting palm tree fruits. Tourism is another potential source of income on the island, albeit accessible to a limited number of community members.

Fishing livelihoods in Saint Louis

The Wolof fishing communities residing on the dune strip known as the "Langue de Barbarie" are confronted with significant climate-related challenges that manifest in various ways. The dune strip's exceptionally low topography makes it highly susceptible to numerous environmental stressors, including ocean currents, tides, frequent and intense storms, strong winds, and a lack of natural vegetation to stabilise the sandy soil (UN-Habitat 2001). This region is acknowledged as one of the most vulnerable areas in Africa to sea-level rise and coastal erosion.

The densely populated sand strip, where traditional artisanal fishing communities have resided for centuries, has been prone to natural hazards such as severe floods and storm surges. These events have resulted in human casualties, economic losses, and damage to infrastructure. Between 2018 and 2019, over 315 households lost their homes and possessions due to these calamities. In addition to homes, a mosque and a school

were also destroyed. Instead of rebuilding the damaged houses, a decision was made to construct a protective dike. As a result, approximately 3,000 affected individuals were relocated to mobile housing units at the site of Diougob, which falls under the jurisdiction of the municipality of Gandon. Diougob is located inland, and it takes about 40 to 60 minutes by bus to reach from the residents' location of origin.

The resettled populations in Diougob no longer face the risk of flooding, but their living conditions present significant challenges in maintaining a sustainable livelihood and accessing basic services. The housing units lack access to water, electricity, and other essential infrastructure. These "baches," which host entire families, consist of just one room. As a result, toilets and kitchens are located in shared spaces. The absence of health services, markets, or mosques further compounds the difficulties faced by these residents.

The closure of existing formation centres at the site of Diougob has had negative consequences for the resettled population. The lack of information, flexibility, time, and community embeddedness has affected these individuals. Study participants reported that people in Diougob have less time to eat, which has led to a reduction in the number of meals they consume each day, often decreasing from three or four to just two meals. Additionally, resettled people have experienced a decrease in income since their relocation. Despite the risk of flooding near the sea and their families, these individuals expressed a preference for their previous living conditions over life in Diougob.

The forced displacement to Diougob has also had a negative impact on social cohesion and community support. While more than one-third of study participants from Santhiaba, whose populations have not undergone relocation, are members of an association, there are almost none in Diougob. Additionally, significantly more people in Santhiaba have access to cooperative funding systems compared to those in Diougob. The lack of community support and essential infrastructure has made work related to the caring of family members and others in need more complicated, particularly for women.

As families' livelihoods are still fully based on fishery, the resettled people go to Guet Ndar to find the missing infrastructures and go about their economic activities in fishery. The irregular or unsuitable schedule of the bus leads to missing out on information regarding departure and arrival of boats, affecting the income of selling women and fishing men.

Photo: *L. Medina*

Testimony from a young man during Saint Louis

"The ocean does not have enough fish anymore to provide for all the fishers. We would like to work in a different field but fishing is an obligation for us. The formation centres on the site of Diougob are only for women and they do not exist anymore. Our income has decreased a lot since the resettlement. We do not have the information when the boats are going to leave. We are missing out on a lot."

An increasing scarcity of fish resources has made it challenging for people in Diougob and Santhiaba to feed their families and maintain their livelihoods. This issue is particularly pronounced during the rainy season when many men do not engage in fishing. Populations across "Langue de Barbarie" have limited alternative economic activities available, and as older men lose the physical strength required for boat work, they often find themselves lacking economic opportunities. It's worth noting that boys typically start going fishing at a very young age, around 6-7 years old, and retire from this occupation by the age of 25, as they can no longer meet the physical demands of the job.

Coastal erosion, which is occurring at an estimated rate of around 1 meter per year, has added to the challenges of sustaining livelihoods in the region. The shrinking width of the "Langue de Barbarie" has reduced the available space for economic activities that take place on the beach, such as fish processing (drying, smoking, salting) by women. Pollution from smoking the fish has harmful effects on the environment and the health of these women. To smoke the fish, trees like Filao, which serve as windbreakers, and Mangroves, which stabilise the sandy soil, are cut down, exacerbating beach erosion.

In 2003, the government of Senegal decided to "save" the old city from a two weeks enduring flood by opening an artificial river mouth south of the island of "Langue de Barbarie". This initially 4-meter wide opening very quickly opened up and now expands to a 6 km wide opening. Since the intervention the old city of Saint Louis, an UNESCO world heritage, has not experienced major flooding anymore. However, there have been a multitude of severe consequences for the ecosystems and inhabitants of islands around. These problems include the destruction and resettlement of two entire fishing villages, the salinization of the Senegal River and adjacent agricultural lands in Gandiol, the extinction of species in the river, alterations in morphological characteristics, and life-threatening risks for artisanal fishers. The land encroachment that has taken place has significant environmental and social consequences.

In addition to the destruction of habitats, the advancing sea has had a profound impact on local fishing, market gardening, and livestock production. Prior to the construction of the breach, fishing boats had the flexibility to operate in both the Senegal River and the Atlantic Ocean, depending on various factors such as the season, weather, and sailing conditions. However, the breach has resulted in the destruction of important fish breeding grounds in the mangroves and the mixing of seawater with freshwater in the

river. As a result, fish stocks have experienced a rapid decline. The currents between the Senegal river and the Atlantic ocean can be very strong and unmanageable for the narrow wooden boats, posing a high risk on fishermen when conditions are stormy. Tragically, participants explain that more than 800 fishermen have lost their lives in the strong currents of the breach since 2003.

The coastal flooding in Saint Louis has resulted in elevated salt levels in the soil and groundwater of the region. This increased salinity has had several negative impacts on the area's biodiversity and agricultural productivity. In the past, the region supported a wide variety of fruits and vegetables that could be cultivated year-round. However, the current salinity levels have restricted successful cultivation to only two species of onions. Additionally, the shortage of uncontaminated water sources and grazing land has forced livestock breeders to downsize their herds. The costs associated with maintaining large herds have become economically unviable in the face of these challenges. This has further contributed to the economic strain experienced by the local population.

Overall, participants of the study report an increase of temperature in the last few years. Especially the displaced families in Diougob complain about the unbearable heat they are facing since the resettlement.

In general, Senegal's artisanal fishery currently experiences a crisis. Over recent decades, a gradual decline in landings and a shift from high-value to low-value fish in artisanal fishery has been noticeable. Reasons for these developments are legal industrial fishing and export of high-value fish to Europe and the US, illegal, unreported and unregulated fishing, increased export of low-value, processed fish to other sub-Saharan countries and the increased export of fishmeal and oil factories' products. The presence of these factories in the fishing industry has resulted in competition for pelagic fish resources between these factories, fishmongers, and processors (Greenpeace Afrique & Foundation Changing Markets, 2021). This competition has led to a scarcity of fish in the local market, causing higher prices and job losses in the artisanal processing sector.

The construction of gas and oil extraction platforms by companies like BP and Kosmos Energy in the waters off Saint Louis has had a significant impact on the local fishing industry. Fishers have reported that these platforms have further reduced their catch. The sandbank where one of the platforms was constructed, known in Wolof as "Djattara," used to be a prolific fishing ground and a breeding site for fish. However, fishing boats are now prohibited from operating close to these platforms.

While the negative effects of the fishmeal and oil industry are predominantly experienced by women involved in fish processing, the overall decline in fish catch poses a threat to the food security of the entire local population. Moreover, it has repercussions for the employment of artisanal fishermen and processors, exacerbating economic challenges in the community.

Adaptive capacities and responses to climate change in Saint Louis

Adapting to the environmental changes noticeable on “Langue the Barbarie” has been difficult as the dune spit is densely populated and there is no alternate habitat with access to water in Saint Louis. Participants reported that NGOs have done sensitisation work with women concerning the cutting of mangroves and Filaos for fish processing activities. However as culture and life is deeply ingrained in artisanal fishery and education levels are low due to the fact that children start working in fishery at a young age, adaptive capacities towards developing alternative sources of income are low.

As a reaction to the 2018/19 flooding, the municipal development agency was charged to build a 5m deep and 2 km long dike to protect the first houses from Gokhou Mbathie to Guet Ndar from floodings, sea-level rising and coastal erosion. Since the dike was built in 2022, the population on the island feels much safer and claims that beach erosion has stopped.

The Senegalese Government and the World Bank have proposed a large-scale resettlement project for the “Langue de Barbarie” region, which aims to relocate approximately 15,000 people to the town of Diougob by 2024. As part of this project, the first 20 meters of the beachfront in the “Langue de Barbarie” area are slated for removal. The resettlement plan involves a total of 432 concessions, affecting 1,027 households. Construction of long-term, uniform-sized houses is underway next to the temporary housing site in Diougob. The families already displaced and residing in temporary housing are expected to move into the long-term houses once construction is completed. However, the affected population has expressed concerns about this resettlement, arguing that the uniform house sizes may lead to social instability and increased vulnerability.

The depletion of fish stocks in the region has led to significant changes in fishing practices. Fishers now have to go on longer and more distant fishing trips, with some lasting up to 7 days. To accommodate these longer trips, traditional fishing boats, known as pirogues, have increased in size from an average of 15-16 metres to approximately 23 metres. This expansion in size has made it challenging to transport the boats on land, and as a result, they are no longer positioned on the beach but on the river side of the island. This change in boat placement means that fishers must now cross the breach, an area with potentially strong currents, when going fishing and returning. Crossing the breach poses additional risks for fishermen, given the currents and weather conditions.

To address these increased risks, a signalling system has been introduced. This system uses coloured flags to indicate whether it is safe for fishing or if conditions are too stormy to cross the breach. Fees or penalties may be imposed on those who do not comply with the signalling system, further emphasising the importance of safety during fishing expeditions.

How do rural communities adapt to climate variability and shocks

Although some coping strategies may contribute to short-term safety, others are practices of maladaptation and frequently carry consequences that can potentially reduce the adaptive capacity of households and communities in the long-term. Resulting impacts from investing in short-term responses to crises, will likely worsen the underlying drivers of vulnerability, such as poverty and illiteracy, thereby hindering local resilience to climate-related security risks in the future. On the other hand, adaptive strategies that are based on collective management of resources, increasing the degree of agency and representation of communities in natural resource management, and the protection of sustainable livelihoods were found to currently enhance the adaptive capacities of communities.

PASTORAL ADAPTATIONS

- Expansion and diversification of herding migratory routes
- Access to new areas with better pasture
- Adopt sedentary lifestyle and rely less on herd migration
- Create financial buffers for unpredictable expenses with informal savings groups
- Farming of grass for fodder and construction of storage facilities
- Pastoral units for the management of pastoral resources and transhumance processes
- Added-value activities, such as transformation of milk into secondary food products

FARMING ADAPTATIONS

- Diversify crops (agroforestry systems, crop rotations)
- Adopt drought- and pest-resistant varieties
- Build storage facilities for harvest, transformation of harvests in long-lasting products
- Adopt mixed-farming methods (integrated crop-livestock systems)
- Conservation agriculture
- Invest in irrigation
- Farm-level flood management

FISHING ADAPTATIONS

- Increase fish processing capacities
- Establish oyster and fish farms
- Travel further into fishing zones with collectively managed large boats
- Diversify income strategies, e.g. tourism
- Shift to non-fishing livelihoods, e.g.tourism and artisanal products (jewellery etc.)
- Signalling “red flag” for bad weather conditions in the village and fees for boats if they are leaving anyways
- Building of sand dunes and soft structures
- Building a dike for protection

SOCIO-CULTURAL ADAPTATIONS

- Travelling farther for trade and markets
- Maintaining good interrelationships with neighbours
- Concerted efforts to preserve local Indigenous culture and languages

PEACEBUILDING ADAPTATIONS

- Dialogues between farmers and herders during conflict through pastoral units
- Neighbourhood surveillance system to prevent livestock theft
- Cultural and traditional mechanisms for conflict management in case dialogue fails
- Village chiefs (traditional institutions) mainly in charge of intercommunity relationships and management of relations between farmers and herders, as well as, access to natural resources

ECONOMIC ADAPTATIONS

- Selling harvest in advance to receive capital to purchase agricultural inputs (e.g. fertilisers, seeds)
- Saving money through informal saving groups (e.g. mainly practiced by women)
- Migration to urban areas in search of employment
- Search for non-agricultural livelihoods

HOW ARE CLIMATE CHANGE, INSTABILITY AND CONFLICT INTERLINKED?

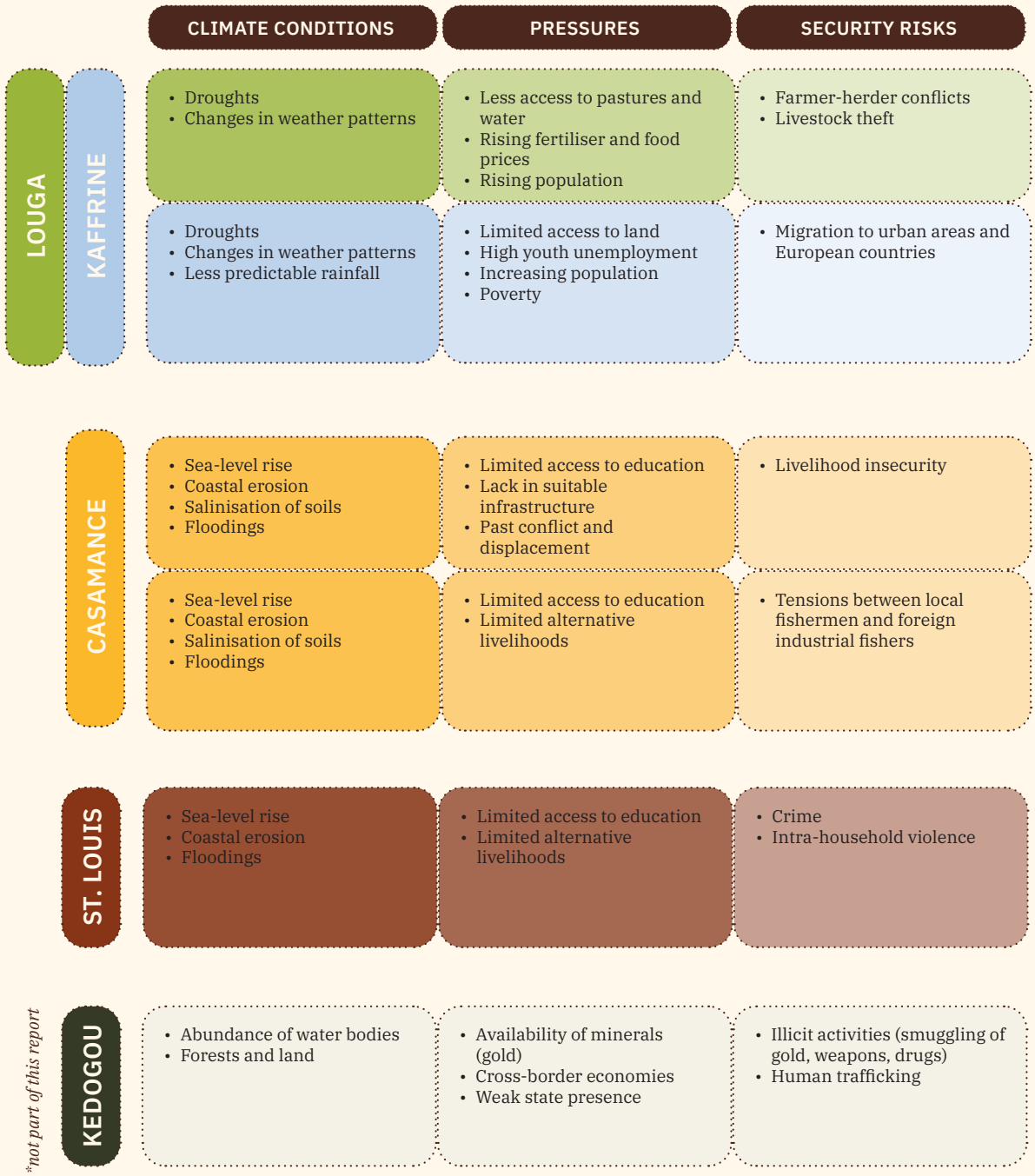

Figure 9. *Summary of climate-related security risks in Senegal .*

Senegal is highly vulnerable to the effects of climate change. Rising temperatures, changing precipitation patterns, and sea-level rise pose significant risks to the country's agriculture, water resources, and coastal areas. Vulnerable populations, especially in rural areas, are disproportionately affected by these impacts. Climate-induced resource scarcity, such as water and arable land, can exacerbate conflicts within communities and between different regions. Additionally, climate-related displacement and migration are becoming more common as people seek more habitable areas, potentially leading to conflicts over resources and increased pressure on urban centres. Climate change interacts with a variety of environmental, socioeconomic, political and cultural factors that act as structural and underlying drivers of conflict. Although there are many similarities in the socio-economic characteristics of the assessed sites, and on the climate hazards that participating communities experience, we found clearly distinguishable narratives on the compounding risks between climate, peace and human insecurity.

Pathway 1: The effects of climate change over natural resources can exacerbate inter- and intra-community conflicts revolving around access to resources.

Climate change threatens previously achieved progress in conflict management concerning the utilisation of natural resources by pastoralist communities.

Across northern Senegal, the transhumance livestock herding system continues to be the predominant mode of production within pastoralist societies. During the parched periods, mobile pastoralists frequently find themselves entangled in competition with local communities for access to critical grazing lands and watering points. Moreover, incidents of crop damage wrought by roaming livestock often serve as a recurring catalyst for disputes.

Over the past decade, the reinforcement of institutional frameworks, notably pastoral units, has provided crucial support to herding populations by facilitating collective resource management. This has been accomplished through the establishment of localised regulatory codes governing resource utilisation and transhumance practices. Nevertheless, it is imperative to acknowledge that local communities have discerned substantial challenges undermining the positive impacts realised thus far by these pastoral units.

Within the context of climate change, the incidence of more frequent and protracted droughts, coupled with escalating variability in rainfall patterns, has precipitated an influx of herders from northern regions. In a scenario where the availability of water and pasture resources is diminishing due to climate-induced alterations, the influx of herders from the north poses a significant risk of overwhelming the existing institutional mechanisms designed to manage conflicts. Consequently, this exigent situation warrants a comprehensive reassessment of conflict resolution strategies and the fortification of adaptive measures to ensure the sustainability of resource management practices in the face of evolving climatic challenges.

Climate change can amplify the occurrence of farmer-herder conflicts centred around land access and crop protection.

The observable shifts in climate patterns, marked by rising temperatures and heightened variability in rainfall, have imparted substantial impacts upon both agricultural and livestock sectors. These climatic alterations have increased the need for farmers and pastoralists to secure reliable access to arable land and pasture. In response to escalating water scarcity, farmers have resorted to expanding their cultivation areas, frequently encroaching upon transhumance corridors and communal grazing lands traditionally devoted to pastoralist activities.

The expansion of agricultural boundaries often affects herders' mobility, curtailing their access to water sources and pasturelands. Concurrently, the increased availability of agricultural waste within cultivated areas leads to a perceived uptick in cattle wandering into farmlands. This dynamic interaction between farmers and herders generates tensions and sporadic outbursts of violence, often manifested as retaliatory actions following the imposition of compensation demands for crop damage caused by livestock.

In a bid to avoid these conflicts, local governments and community leaders in the Kaffrine region have frequently resorted to imposing restrictions on pastoralist groups, delineating specific periods during which they are permitted to enter designated territories, typically after the harvest season. However, the intensification of drought conditions, wrought by climate change, casts doubt upon the feasibility and willingness of herders to adhere to these restrictions. The confluence of these climate-induced challenges and the persisting conflicts necessitates a comprehensive and adaptive approach to mitigate the potential for escalation and foster coexistence between these vital sectors of rural livelihoods.

Moreover, it is imperative to acknowledge that the unilateral formulation of bylaws, wherein local farming communities curtail the movement of external pastoralists without engaging in a consultative process, has the potential to exacerbate grievances between these distinct economic groups. Hence, fostering a more inclusive and collaborative approach to the development of regulations and conflict resolution mechanisms is essential to mitigate tensions and promote harmonious coexistence within these dynamic and climate-vulnerable landscapes.

Increasing reliance on fishery due to the loss of agricultural livelihoods exacerbates tensions between local fisherfolk and foreign industrial fishers.

The Casamance River estuary is currently witnessing tensions between local fisherfolk and foreign industrial fishing operations. This discord has been brewing over the past two decades, during which the Senegalese fishing industry has grappled with a severe crisis characterised by dwindling fish stocks and a diminishing contribution of the fishing sector to Senegal's GDP. The depletion of fish stocks can be largely attributed to the impact of industrial fishing conducted by foreign vessels and the prevalence of illegal fishing activities.

Climate-related effects further compound the challenges faced by the fishing industry by affecting agricultural productivity as an alternative source of income, and by reducing the availability of fish stocks. These climate-induced changes exacerbate preexisting conflicts and tensions surrounding resource access and utilisation, pitting artisanal and industrial fisherfolk against each other. Although disputes between local and industrial fishers have rarely escalated to violence, there is a growing undercurrent of resentment among local populations towards industrial fishing operations.

For example, conflicts at sea have been reported between local fishermen and industrial vessels around Saint Louis. Initially, conflicts arose between local fishermen and Mauritanian state authorities before fishing licences were reorganised in 2018. There were also accounts of industrial Chinese vessels colliding with artisanal fishing boats at sea, although these incidents appear to have subsided. More recently, conflicts have emerged between fishing communities in Senegal, with tensions observed between the community of Kayar and other fishing communities along the coast in 2023. These conflicts indicate the complexities and challenges within the fishing industry and its interactions with both local and foreign actors.

Moreover, the reduced availability of fish stocks has forced some fishermen to adopt riskier practices, such as venturing farther out to sea. This practice, while a coping mechanism for economic hardship, exposes these fishermen to heightened risks of injury, loss of equipment, and even loss of life.

Pathway 2: A proliferation of unlawful activities among youth are exacerbated by the erosion of livelihoods attributed to climate-induced threats.

Climate-related shocks and the associated variability exert a direct and far-reaching impact on the livelihoods of individuals, primarily manifesting as the loss of crops and livestock, as well as a decline in forest productivity. A vulnerability assessment has pinpointed three principal climate-related perils disproportionately affecting populations: the impact of strong winds, protracted periods of drought, and inundating floods. A disconcerting trend arises from the escalating loss of livestock during prolonged dry seasons. This trend coincides with the period when communities are grappling with severe challenges in terms of dwindling food reserves and financial resources. Consequently, the populace's capacity to replace their livestock or procure sustenance from local markets is perilously compromised.

Moreover, the shifting climate patterns have rendered certain staple crops, which communities depend upon, unsuitable for cultivation due to protracted dry periods, untimely storms, and more concentrated precipitation during the rainy season. The heightened frequency and intensity of floods, experienced across all regions of Senegal, compound these challenges by impeding people's ability to access vital markets, thereby exacerbating the perils of food insecurity. In addition to the loss of livelihoods, climate-

induced disruptions erode social capital and diminish collaborative capacities among neighbours. This erosion of social cohesion and community resilience amplifies the vulnerability of affected populations.

Compounded by chronically low income levels and precarious food security, individuals are increasingly driven towards engaging in petty criminal activities as a means of survival. A case in point is the observable surge in cattle theft in the Louga region, which is perceived to closely correspond with the onset of extended dry-spell episodes. The confluence of livelihood deprivation and the dearth of viable alternative employment opportunities significantly heightens the proclivity of youth populations to engage in illicit undertakings, encompassing illegal logging, acts of banditry, and theft. This multifaceted interplay between climatic pressures, economic adversity, and illicit activity underscores the complex and indirect effects of climate over societal stability.

Participants in Saint Louis also relate decreasing fish stocks with an increase in social instability. The majority of people in this case study explained that there is an increase of violence, criminality and conflict noticeable during the last five years. In particular, class conflicts between boat owners and fishermen have increased due to insufficient salary payments at the end of the season. As a consequence there have been raids and burning of houses of boat owners on “Langue de Barbarie”.

Pathway 3: The loss of livelihoods increases the incidence of within-country and irregular cross-border migration, which poses security threats to people on the move.

The loss of livelihood security is furthermore associated with increasing migration towards urban areas within Senegal and beyond national borders. Migration processes are thought to be related to insecurity risks faced by migrants, as people moving into Senegalese cities and foreign countries commonly face risks associated with settling under vulnerable conditions, including low employment opportunities, poverty, climate disasters, and crime. Many participants in Saint Louis, Louga, and Kaffrine explained that family members did not see any other option than to embark on irregular migration to Spain. These challenges posed to livelihood stability and the lack of alternative options are thought to be exacerbated by the loss of farming, pastoral and fishing livelihoods due to the effects of climate change.

Migration is closely intertwined with a web of insecurity risks confronting migrants. As individuals embark on journeys towards Senegalese cities and foreign nations, they are frequently subjected to a plethora of risks associated with their precarious settlement conditions. These risks encompass, but are not limited to, the dearth of gainful employment prospects, entrenched poverty, the spectre of climate-induced disasters, and exposure to various forms of criminality. This climate-related security risk was discussed in all communities participating in this study. For example, Saint Louis is one of the largest ports of departure for out-migration by pirogue, aiming for the Canary Islands.

The up to 14 days at sea are life-threatening, and the risks associated with such journeys have dire consequences for those attempting this perilous path.

The nexus between livelihood insecurity and migration is especially pronounced within Senegal. It underscores the compelling imperative to address the manifold challenges faced by migrants as they endeavour to secure a sustainable existence in new and often unforgiving environments. These challenges encompass not only economic precarity but also the imperative to grapple with the far-reaching consequences of climate change and the looming spectre of human rights violations related to migratory processes.

Pathway 4: Loss of livelihoods, food insecurity, and ineffective responses by state-authorities to climate threats undermine political legitimacy and exacerbate societal instability.

Climatic perturbations pose a twofold threat to food security. Firstly, they directly diminish agricultural yields, reducing the availability of essential sustenance. Secondly, they indirectly drive up the cost of food, rendering it increasingly unaffordable for vulnerable populations. Research participants have linked escalating hardship and food insecurity to a diminishing sense of legitimacy attributed to government authorities. This erosion of trust effectively exacerbates the risks of political instability and social unrest. Recent instances of forceful responses by the Senegalese government to social mobilisation within the country serve as a stark reminder of the security implications stemming from societal discontent and diminished governmental legitimacy.

Government responses to climate threats also contribute towards eroding political legitimacy. For example, inhabitants of the “Langue de Barbarie”, in Saint Louis, are resistant to the idea of relocation. Some individuals who were impacted by the 2019 flooding have even rebuilt their houses near the coast, indicating a general reluctance to leave their traditional homes and livelihoods. There is a large resentment of the population in Santhiaba and in the resettled area regarding the planning and operationalisation of the resettlement projects. However, promised aid for the affected population during the resettlement process is also perceived as insufficient.

These grievances are related to issues of corruption, nepotism, and a lack of transparency in the allocation and management of project funds. Political participation in the projects is also viewed with suspicion. The unequal treatment of affected individuals in terms of aid payments and concessions within the resettlement project has exacerbated existing property relations and disadvantaged those who have already been displaced to Diougob. This unequal treatment and perceived favouritism have contributed to a sense of injustice and discontent among the affected communities. Overall, the resettlement project led by the World Bank and the Senegalese government appears to have encountered limited social acceptability and faces significant challenges related to governance and equitable resource distribution.

People in Saint Louis perceive a high incidence of robberies, banditry, sexual abuse, and other forms of crime. This violence is associated by local populations with poorly planned relocation processes in the site of Diougob. Focus groups explain that temporary housings can easily be cut open with a knife and get robbed. Within the community, there are often conflicts and fights, especially when multiple families share a small number of toilets. The lack of proper sanitation facilities has been a source of tension and violence. The non-availability of water on the site is also a significant issue. Women have to fetch water in the middle of the night, which exposes them to more insecurity, making their daily lives even more challenging. Participants expressed concern that this situation will only get worse when families are moved to smaller houses, as currently planned.

Pathway 5: A historical backdrop marked by conflict has significantly eroded the collaborative and adaptive capacities required for resilience-building in Casamance.

While Senegal has enjoyed relative stability within the Sahel and the broader African context, the conflict in Casamance, primarily during the 1990s, left a lasting impact on communities residing in the islands along the Casamance River, including Diogué, Carabane, and Niomoune. This protracted conflict disrupted the thriving fishing activities in the region, which had been an economic mainstay, resulting in the breakdown of public and financial services and hindering access to crucial markets. A substantial portion of the population was forced to migrate elsewhere, only returning at the end of the decade when violence had subsided. In the aftermath of the conflict, fishing communities in the area demonstrated a remarkable reservoir of social capital and established a notably peaceful society. They actively organised for the implementation of measures to combat coastal erosion, employing various solutions such as sand dams, mangrove restoration, and beach rehabilitation.

However, despite these concerted efforts, the onset of the new millennium has witnessed an alarming acceleration of coastal erosion, exacerbated by the effects of climate change and compounded by external factors like industrial overfishing. This multifaceted challenge now threatens to overwhelm the collective capacity of the Jola people to comprehensively rebuild their society, revive cultural traditions, and fortify their resilience against the backdrop of mounting climate variability and sea-level rise. In this context, the historical legacy of conflict, combined with contemporary environmental stressors, underscores the urgency of holistic interventions that address not only the immediate environmental threats but also nurture the social and economic resilience of these communities.

Pathway 6: Accelerating coastal erosion is precipitating a series of challenges, including the reduction in available land and the heightened risk to both public and private infrastructure. These developments are stoking tensions among neighbours.

The islands within the estuary are currently grappling with a relentless onslaught of coastal erosion, resulting in the loss of substantial tracts of coastline. In certain locations, hundreds of metres of land have succumbed to submersion. This erosion has rendered previously arable and habitable land unusable. Even critical structures like a public school have had to be relocated due to the encroaching sea.

A notable traditional practice among the Jola communities involves land borrowing, wherein landowners generously grant access to other families for farming purposes when they do not require the land for their own subsistence. Commercial leasing of land is not a customary practice within the community. While this practice fosters social cohesion and enhances collective adaptive capabilities, it has also been reported to engender disputes among community members, especially when landowners seek to reclaim the land they had lent to others. The loss of farming land has become increasingly pronounced due to coastal erosion, prompting some individuals to request the return of their land, even after several years of lending it to others.

In cases where neighbours decline to return borrowed land, the intervention of village chiefs and traditional authorities has proven to be an effective mediation strategy. However, these interventions are perceived to be associated with disagreements and lingering resentments among neighbours. Consequently, the exacerbation of land-related disputes within these coastal communities necessitates a balanced approach that respects both customary practices and the evolving environmental challenges they face.

RECOMMENDATIONS FOR CONFLICT-SENSITIVE RESILIENCE BUILDING

According to the perceptions of participants in this study, the climatic drivers of insecurity and instability are expected to intensify in the coming decades. Projections indicate increases in average temperatures, greater variability in rainfall patterns, and a heightened risk of drought as the climate continues to evolve (Trisos et al., 2022). Unless adaptive capacities are significantly enhanced, these climate-induced changes are likely to have profound repercussions on people's ability to ensure food security and maintain stable livelihoods. Additionally, these changes will place increasing strain on institutional capacities to manage natural resources and conflicts, deliver public services and provide social protection.

The findings from this study strongly suggest that if these evolving insecurities are not effectively addressed, they may worsen in the face of more challenging climate conditions. However, it's worth noting that the management of natural resources and climate adaptation efforts can also serve as catalysts for cooperation among conflicting groups. Such collaboration can contribute to the establishment of resilient institutions capable of mitigating threats to reduced social cohesion and stability. The study participants have put forward practical proposals on possible adaptation activities, taking into consideration the current state and management of natural resources and climate change impacts. These proposals largely rely on collective action within their communities. Nonetheless, they also emphasise the need for support from regional and national policy systems and the need for attention from the international community.

Proposals for community-level adaptation activities are rooted in the specific social, environmental, economic and political characteristics of each case study area, the distinct climate threats faced by communities, and the nature of the group- and individual-level relations among local actors. Collaboration involving diverse stakeholders, including practitioners, policymakers, researchers, regional actors and community members, can have the potential to establish a setting for empowering local communities and generating innovative solutions for climate adaptation that can also serve as instruments of peace.

Louga case study

To ensure the continued success and fortification of previous achievements in managing conflicts related to natural resources involving Senegalese herders and farmers, it is imperative to adopt a collaborative and multi-stakeholder approach within the governance systems that regulate natural resource management and transhumance processes. This approach should bridge the divides among various livelihood groups and foster cooperation between governmental and non-governmental entities. In response to these challenges, adopting a collaborative governance approach that spans municipalities within the semi-arid areas of Northern, Central and North-Eastern Senegal .

1. **To safeguard the livelihoods of herding communities across agro-pastoral regions in Senegal, a comprehensive set of activities has been considered essential.** These activities could encompass interventions aimed at providing social protection against the impacts of climate-related disasters. Specifically, bundled credit and index-based insurance schemes have been proposed as effective mechanisms to shield cattle-dependent livelihoods from the vagaries of climate change. By combining these two elements, herding communities can be better equipped to cope with the financial burdens and risks associated with climate-related disasters.

2. **Herding communities recognise that the impacts of pastoral units have been curtailed by incoherent regulations across municipalities, thereby reducing the capacity of herders on the move to comply with local rules.** Regulations implemented in specific municipalities, however, tend to be tailored towards context-specific territorial conditions. A collaborative governance approach across municipalities, hence, could contribute towards defining locally-tailored regulations while maintaining a degree of consistency across main migratory routes. Furthermore, it's essential to acknowledge that there are still many villages and pastoral communities that have not yet joined the collaborative approach to resource governance advocated by pastoral units, for reasons that need to be investigated further. Expanding engagement at the municipal level could serve as a catalyst for the wider adoption of this practice, thereby enhancing the sustainability of natural resource management and conflict resolution efforts. By fostering a shared sense of responsibility and cooperation among various stakeholders, this collaborative governance approach paves the way for a more resilient and harmonious coexistence between farmers, herders and agro-pastoralists in the region.

3. **Practical solutions to the low-degree of compliance of local regulations by migrant herders included strengthening the system of migratory corridors currently in place, and to delineate pastoral corridors in regions where they have not yet been set.** Strengthening these systems could be achieved in part by implementing measures that support incoming pastoralists in understanding local regulations to which they need to abide. A practical approach was proposed by pastoral communities, involving the creation of resting areas for herders on the move, where they could access all required information regarding local regulations. These spaces would also act as locations for the management of disputes among herders and between farmers and herders, whereby local government authorities, pastoral units and disputing parties can negotiate while embedded in a locally-suitable context, such as the same territory in which the dispute is embedded.

4. **Diversify livelihoods by investing in infrastructure and capacities for milk processing. Women are usually charged with selling the milk, but they have lacked capacity building processes to learn alternative modes of income by transforming milk into other products.** There is a need to invest in the required infrastructure and capacities for added value of milk, as well as other livestock derivative products. Establishing milk processing facilities at the community or cooperative level can facilitate the transformation of raw milk into value-added products such as cheese, yoghurt, butter, and powdered milk. Providing training and capacity-building programs, particularly for women, on milk processing techniques, hygiene, product development, and marketing can empower them to take on new roles in the value chain and explore entrepreneurial opportunities. Utilising local fruits for oil production is another promising income-generating opportunity. Establishing fruit processing units to extract oils, produce jams, or make fruit-based products can provide a valuable source of income, especially when these products are marketed in nearby urban areas.

Kaffrine case study

Promoting increased engagement and collaboration among farming and pastoral livelihood groups is recognised as an essential strategy for addressing transhumance-related conflict risks. Transhumance, the seasonal movement of herders and their livestock in search of pasture and water, often intersects with settled farming communities, leading to potential conflicts over land and resources. To foster peaceful coexistence and minimise these conflicts, it's important to encourage cooperation and dialogue among these different livelihood groups. Beyond risks of conflict over natural resources, farmers in Kaffrine focused on the protection and expansion of rural livelihoods, particularly for the youth, the protection of migrant populations, and the capitalisation of migratory processes for resilience building.

1. **Increase engagement and cooperation across different livelihood groups as a strategy towards mitigating transhumance-related conflict risks and promoting peaceful coexistence in farming regions.** 1) Ensure that the process of defining local regulations, such as entry dates for herders into specific localities, is inclusive and incorporates the perspectives and concerns of both herding and farming communities. 2) Strengthen coordination mechanisms that involve various stakeholders, including municipalities, local authorities, community-driven organisations like pastoral units and agricultural associations, and representatives from both herding and farming communities. 3) Develop and promote effective conflict resolution mechanisms that can swiftly address disputes or conflicts that may arise between herders and farmers. These mechanisms should be transparent, fair, and easily accessible to all parties, promoting a culture of peaceful conflict resolution. 4) Recognise the evolving climate threats and their impact on transhumance practices. Regulations should be flexible and adaptive, taking into account changing weather patterns and the needs of both herders and farmers.

2. **Increase access to irrigation water to facilitate dry season agriculture and expand labour opportunities for young people in regions like Kaffrine.** Additionally, fostering the availability of longer-term credits for agricultural investments, such as irrigation technology, could significantly boost agricultural productivity for local communities. People in Kaffrine, for example, would be willing to adopt a years-long credit or joint credit scheme that allows them to install irrigation technology. Participants, mainly women, identified the need to encourage the formation of farmer cooperatives or associations that can collectively invest in irrigation infrastructure. Cooperative models, such as women-led savings groups, can help spread the costs and risks while ensuring sustainable management of irrigation facilities. However, the overuse of groundwater for irrigation could rapidly drain water resources in the region if not properly managed. The deployment of Water Security Committees that oversee water extraction was deemed a necessary follow-up to this proposal.

3. **Facilitate the exchange of information between different livelihood groups. Providing herders with information about local regulations and farming seasons, and farmers with insights into the needs and challenges of herders, can foster mutual understanding and cooperation.** Implement a programme to increase the availability of information regarding the occurrence of transhumance processes. A system of gathering and sharing information, involving social media platforms such as WhatsApp, radios and an increasing role of collaborative entities like the pastoral units, could support the dissemination of information on transhumance processes in ways that increase coordination between local and incoming populations. Furthermore, this system should also integrate climate-related information that supports herders and farmers in preparing for the following season.

4. **Enhancing the value of agricultural products is a significant priority for farming communities in Kaffrine.** Currently, there is limited value addition through the processing of agricultural products, but there are ample opportunities for improvement. There is a need to encourage farmers to diversify their crops by planting higher-value crops alongside staple crops like peanuts, millet, maize, and beans. This diversification can include the cultivation of vegetables, baobab fruits, and other local fruits that have higher market value. This, however, requires investing in processing infrastructure that allows for the transformation of raw agricultural products into value-added goods. This can include facilities for processing peanuts into peanut butter, millet and maize into flour or cereals, or fruits into jams, juices, or dried products. Local cooperatives or processing units can be established to facilitate these processes. These efforts need to be accompanied by the provision of capacity-building programs for local farmers and entrepreneurs to develop the skills and knowledge required for effective processing and value addition, and to facilitate access to markets for processed agricultural products.

5. **Empower local communities to effectively coordinate with migrants, both within Senegal and abroad, as a valuable strategy for building resilience and leveraging migration as a positive force for community development.** Establishing community-level organisations that facilitate the sharing of migratory experiences and best practices between those who stay and those who leave can enhance the capacity of community members in several ways. This organisation can serve as platforms for sharing knowledge, skills, and experiences related to migration. Migrants can provide insights into successful strategies for employment, income generation, and adaptation to new environments. Migrants also often engage in entrepreneurial activities and bring back innovative ideas and practices from their experiences abroad. Community-level organisations can support the development of local businesses and initiatives, drawing on the expertise and resources of both migrants and those who stay to create economic opportunities. Lastly, this organisation can also serve as an advocate for the rights and interests of community members, both locally and at the national and international levels; and help preserve cultural traditions and strengthen the sense of identity and belonging among community members.

Casamance case study

Collaborative coastal management and planning have emerged as a promising solution to preserve the robust social capital and safeguard the well-being of Jola fishing communities in coastal Casamance. One of the key strategies within this approach is the reinforcement of local capacities to coordinate and organise at the community level. This strategy is seen as a potent means to enhance the representation of coastal communities when engaging with government authorities. Importantly, there have been prior initiatives in the Casamance river islands that can serve as a solid foundation to bolster the implementation of this proposal. Leveraging these existing efforts can streamline and expedite the process of enhancing community-level organisation and cooperation. By strengthening the coordination and representation of coastal communities, this collaborative approach aims to empower these communities to actively participate in decision-making processes related to coastal management and planning. In doing so, it seeks to promote sustainable practices, preserve valuable coastal and fishery resources, and ensure the resilience of these fishing populations in the face of the complex challenges posed by coastal erosion and climate change.

Across the wider Casamance region, local-level NGOs currently focus on strengthening social cohesion and preventing land-related disputes emerging during relocation processes of populations forcefully displaced during the protracted armed conflict. These are crucial factors for a sustainable peacebuilding in the region, which could be accompanied by climate action and nature conservation. Increasing climate variability, such as unpredictable heavy rains, and slow-onset climate impacts, such as sea-level rise, are taking a toll on current productive systems in communities which are, to this day, recovering from the conflict. In Casamance, nature-based solutions should be geared towards soil preservation, water retention and more broadly conservation of resources. The region is characterised by resource-rich environments which should be maintained affluent through interventions preventing the disruption of ecosystem services. For instance, high levels of soil organic matter should be preserved through the composting of leaves obtained from dense forest ecosystems abundant in the region, while freshwater tributaries should be sustained with retention basins. Locally-suitable techniques and strategies to escalate these practices are currently lacking in the region and should therefore be integrated to ensure long-term livelihoods' resilience and favourable conditions for population re-establishment.

In order for climate adaptation efforts to be sensitive towards a post-conflict context, four programming axes were proposed by study participants: 1) adapted technical and infrastructural support, 2) capacity building, 3) project durability, and 4) prioritisation of local knowledge. Infrastructural and technical assistance is critical at this early resettlement stage in the villages surrounding Ziguinchor to ensure communal stability, viability, and resilience.

1. **Collaborative coastal management and planning was proposed as a potential solution to maintain high-levels of social capital and protect fishing populations in Casamance.** Strengthening local capacities for the coordination of a community-level organisation was deemed an effective strategy to increase the representation of coastal communities towards government authorities. This organisation would be charged with mapping coastal erosion and other climate change effects, identifying and classifying local knowledge on climatic and social developments, managing consultation processes to define locally-suitable responses, and engaging with technical or government organisations for the effective implementation of solutions.

2. **Implement measures to organise the gradual retreat of populations from vulnerable shorelines or to prohibit construction in exposed areas.** This demands a comprehensive approach that combines technical expertise, robust institutional capacity, and meaningful engagement with local communities. In this context, supporting Jola communities in developing zonal plans to restrict the construction of buildings and infrastructure in areas susceptible to sea encroachment is essential. Leveraging technical knowledge and expertise is crucial for accurately assessing the vulnerability of specific areas to sea-level rise and coastal erosion. However, it's also important to involve community members in the planning process, listen to their concerns, and incorporate their knowledge into decision-making. This participatory approach can help identify culturally and socially sensitive strategies for retreat and relocation. As sea-level rise continues, it may become necessary to implement assisted relocation measures to support affected communities in finding alternative settlement and livelihood opportunities in safer areas. These relocation plans should prioritise the well-being and cultural continuity of displaced populations.

3. **Support the resettlement processes of former IDPs in the villages surrounding Ziguinchor, through infrastructural and technical assistance.** Apart from requiring support for building houses and clearing land, returnee communities will need useful infrastructures to establish decent living conditions and climate-adapted food production systems. The provision of water retention systems seems to be a priority for these villages, both for supporting household needs and agricultural production.

4. **Empowering local communities to effectively coordinate with migrants, both within Senegal and abroad, is a valuable strategy for building resilience and leveraging migration as a positive force for community development.** Establishing community-level organisations that facilitate the sharing of migratory experiences and best practices between those who stay and those who leave can enhance the capacity of community members in several ways. This organisation can serve as platforms for sharing knowledge, skills, and experiences related to migration. Migrants can provide insights into successful strategies for employment, income generation, and adaptation to new environments. Migrants also often engage in entrepreneurial activities and bring back innovative ideas and practices from their experiences abroad. Community-level organisations can support the development of local businesses and initiatives, drawing on the expertise and resources of both migrants and those who stay to create economic

opportunities. Lastly, this organisation can also serve as an advocate for the rights and interests of community members, both locally and at the national and international levels; and help preserve cultural traditions and strengthen the sense of identity and belonging among community members.

Saint Louis case study

Recommendations by community members in Saint Louis aim to address various issues identified within the region. These include concerns around security and the incidence of violence and crime, poorly managed and inadequate infrastructure for transport and flood management, undignified housing and access to public services, increasing inequality and its effects over social cohesion, the effects of corruption over the distribution of benefits from resilience-building efforts, and diminishing fish stocks. If addressed simultaneously through resilience building, these efforts can improve the overall situation in Diougob and "Langue de Barbarie".

1. **Implement security measures such as increased surveillance, increasing presence of police forces, and proper lighting to ensure the safety of residents and prevent any potential security threats.**

2. **Prioritise the development of basic infrastructure for effective public service provision, mainly reliable drinking water and electricity in Diougob.**

3. **Ensure fairness and equality in the distribution of aid and allocation of newly built houses in the resettlement project.** Implement transparent processes and criteria to avoid clientelism or discrimination.

4. **Increase collaboration between municipal authorities charged with public transportation to improve bus schedules between Diougob and "Langue de Barbarie."** This will enhance accessibility and convenience for residents, facilitating their daily commute and access to essential services and workplace. It will also support fishers and fish processors in conducting their daily livelihoods.

5. **Establish strict anti-corruption measures, strengthen public participation and promote transparency as part of the resettlement project.** Implement mechanisms to prevent corruption and nepotism, such as independent oversight, reporting channels, and accountability measures.

6. **Strengthen regulations and enforcement to reduce the negative effects of industrial and illegal fishing practices in Senegalese waters.** This could involve increased surveillance, penalties for violators, and collaboration with international organisations to address this issue effectively.

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