SALINITY SCOPING STUDY – SENEGAL

Commissioned by the Netherlands Food Partnership

December 2025

SALINITY SCOPING STUDY – SENEGAL: REPORT

Ali Ibrahim

Abdoulaye Sow

Martijn van Staveren

Babette Bodlaender

Viviane Faye

This study was conducted by Africa Rice Center (AfricaRice) and commissioned under the Saline Water & Food Systems (SW&FS) Partnership, jointly convened by the Netherlands Food Partnership and the Netherlands Water Partnership.

Executive summary

Soil salinization is among Senegal's most severe land-degradation challenges, with major implications for agricultural productivity, water resources, and rural livelihoods across contrasting agroecological zones. Syntheses compiled in this study indicate that more than 34% of agricultural land are affected, and that salinity continues to expand in several regions, creating a growing constraint to national food security and the sustainability of high-value production systems. In response, the SW&FS Partnership selected Senegal as one of its priority countries and mandated a rapid, evidence-based scoping assessment to inform a multi-annual action plan and targeted investments. The study has four core objectives: (i) characterize the spatial distribution, drivers, and typologies of salinity; (ii) assess impacts on production systems and water quality; (iii) review existing interventions, institutional arrangements, and gaps; and (iv) identify priority geographies and practical entry points for coordinated action.

Conceptually, salinity is treated as a system-level constraint generated by the interaction of inherited coastal–deltaic conditions, contemporary hydro-climatic forcing, and management-induced processes particularly the expansion of irrigation without effective drainage and sustained operation and maintenance (O&M). This study combines a desk-based evidence synthesis with targeted stakeholder engagement. The desk review triangulates national and institutional reports, peer-reviewed literature, and project documentation from major programs, complemented by academic research outputs to strengthen interpretation and program relevance. Stakeholder engagement uses purposive sampling to capture diversity in mandates (water, agriculture, environment, research, extension), exposure geographies (Delta, Sine–Saloum, Casamance, Niayes), and user groups (institutions, producer organizations, communities, and private actors). Semi-structured interviews elicited insights on symptoms, drivers, responses, and bottlenecks in implementation and scaling. Findings confirm that salinity in Senegal is spatially heterogeneous and multi-causal, shaped by marine/estuarine intrusion, shallow saline groundwater and capillary rise, groundwater degradation in coastal zones, and irrigation-induced secondary salinization under weak drainage performance. The study therefore organizes/identifies? "hotspots" as systems rather than administrative units, emphasizing three priority landscapes where risks, impacts, and leverage for recovery converge: (1) the Senegal River Delta (including the Gorom–Lampsar axis), where strategic irrigated rice production is highly exposed to drainage constraints; (2) Lower Casamance rice valleys, where restoration depends on valley-scale water governance and anti-salt infrastructure; and (3) Sine–Saloum coastal lowlands, where estuarine intrusion intersects with high livelihood vulnerability. Stakeholder evidence shows a strong operational conclusion: progress is constrained less by a lack of technical options than by gaps in coordination, organization & management (O&M), and decision support. Research and innovation supply is present where salt-tolerant materials and management options exist but scaling is limited by weak technology transfer pathways, fragmented institutional coordination, and insufficient routine soil monitoring to support adaptive management.

Accordingly, the study's recommendations prioritize: restoring salt removal capacity through functional drainage and enforceable O&M; converting monitoring and diagnostics into operational decisions; deploying integrated agroecological salinity management packages tailored to Senegal's salinity systems; and strengthening multi-actor coordination mechanisms that persist beyond projects. The study also notes a policy opportunity to mainstream salinity within wider environmental and resilience agendas, including biodiversity policy frameworks that recognize salinization as a driver of ecosystem loss, creating pathways for cross-sector alignment and co-financing.

Contents

List of abbreviations

ANCAR	Agence Nationale de Conseil Agricole et Rural (national agricultural advisory/extension agency)
CBD	National Strategy & Action Plan for Biodiversity (linked to the Convention on Biological Diversity)
CCSS	Clubs de Conseil en Santé des Sols (Soil Health Advisory Clubs)
CDI	Charte du Domaine Irrigué (Charter of the Irrigated Domain)
DGPRE	Direction de la Gestion et de la Planification des Ressources en Eau
EC	Electrical conductivity
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
INP	Institut national de Pédologie
IPAR	Initiative Prospective Agricole et Rurale
IRD	Institut de Recherche pour le Développement
ISRA	Institut Sénégalais de Recherches Agricoles
IUCN	International Union for Conservation of Nature
NPK	Nitrogen–Phosphorus–Potassium
OLAC	Office des Lacs et Cours d’Eau
OMVS	Organisation pour la Mise en Valeur du fleuve Sénégal
OP	Organisations Paysannes (farmers’ organizations)
P2RS	Programme de Renforcement de la Résilience
PADERCA	Projet d’Appui au Développement Rural en Casamance
PANA	National Adaptation Programme of Action
PAPIL	Projet d’Appui à la Petite Irrigation Locale
PARETS	Projet pour la Résilience des Écosystèmes
PIP	Private Irrigated Schemes
PIV	Périmètres Irrigués Villageois (village irrigation schemes)
SAED	Société d’Aménagement et d’Exploitation des Terres du Delta du fleuve Sénégal et des Vallées du fleuve Sénégal
SAGA	Sécurité Alimentaire: Agriculture Adaptée
SOMIVAC	Société de Mise en Valeur Agricole de la Casamance
SRV	Senegal River Valley
STRASA	Stress-Tolerant Rice for Africa and South Asia
SW&FS	SalineWater & Food Systems (SW&FS) Partnership
UGB	Université Gaston Berger
UH	Unions Hydrauliques (Hydraulic Unions)
UNESCO	United Nations Educational, Scientific and Cultural Organization
WARDA	West Africa Rice Development Association (former name of AfricaRice)
WWF	World Wide Fund for Nature

List of tables

List of figures

1. Introduction

Soil salinization is now recognized as a major land-degradation constraint in Senegal, with serious consequences for agricultural productivity, rural livelihoods, and the sustainability of key agri-food systems (Fall *et al.*, 2014). Available estimates indicate a substantial and method-dependent national burden. The World Bank (2012) reported that about 645, 000 ha of agricultural land is salt-affected (6.8% of the 9.5 million ha national agricultural area). More recently, UNESCO (2024) reports a much larger figure, suggesting that salinization affects approximately 34% of the national territory, equivalent to around 2.5 million hectares (UNESCO, 2024), underscoring how strongly estimates vary with definitions, mapping approaches, and denominators (territory vs. agricultural land). In the Senegal River Valley, where irrigated rice is strategically important, saline soils were estimated at approximately 179,765 ha, representing >74% of the potential irrigable area (240,000 ha) (Dumas *et al.*, 2010). Using different data sources, van Oort (2018) estimated that 7–15% of rice area is cultivated on saline soils. The economic burden is also significant: for irrigated rice, salinization costs were estimated at US$ 22 million (about 0.2% of GDP) for 28,366 ha affected (Sow *et al.*, 2016). Other national assessments suggest broader ranges, with total salt-affected land reported between 1.0 and 1.7 million ha (Diack *et al.*, 2014) and 996,950 ha estimated by the National Institute of Pedology (INP, 2008). These divergences largely reflect differences in mapping methods, thresholds, reference years, and denominators, but collectively confirm the scale and severity of the problem. Spatially, salinity spans multiple agroecological settings from the irrigated schemes of the Senegal River Valley, to the coastal Niayes horticultural belt, Sine–Saloum lowlands, and Casamance rice landscapes where it constrains crop performance through osmotic stress, ion toxicity, structural degradation, and impaired nutrient availability, ultimately translating into major yield and income losses (Wopereis *et al.*, 1998; Mel *et al.*, 2019; Ibrahim *et al.*, 2025).

The drivers of salinization in Senegal are complex and interconnected. They include marine and estuarine intrusion amplified by sea-level rise, insufficient drainage in irrigated perimeters, groundwater over-extraction in coastal horticultural zones, and landscape degradation resulting from deforestation, soil erosion, and prolonged dry seasons (Diack *et al.*, 2014; Diouf, 2020, Thiam *et al.*, 2019). The combined effect of these processes is accelerating the spread of saline and saline-acidic soils, particularly in Fatick, Kaolack, Saint-Louis, Ziguinchor, and Sédhiou (Drame *et al.* 2019; Diallo *et al.*, 2015). Addressing this challenge requires solutions that integrate hydrological management, soil rehabilitation, climate-resilient agronomy, and local governance mechanisms.

Recognizing the strategic importance of combating salinity for food system resilience, the SW&FS Partnership selected Senegal as a priority country for investment and coordinated action. The Partnership emphasizes a systems approach that aligns interventions across water management, landscape restoration, agronomic innovation, and inclusive institutional frameworks. In this context, AfricaRice was mandated to conduct a rapid but scientifically grounded salinity scoping study aimed at generating evidence to support the design of a multi-annual national action plan. The study was also expected to synthesize stakeholder perspectives, consolidate existing research and data, and highlight opportunities for policy alignment and programmatic investment.

Accordingly, this study pursues four core objectives:

1. Analyze where, how, and why salinity occurs in Senegal, using available datasets, scientific literature, and stakeholder inputs;
2. Map current responses, institutional efforts, and innovation gaps, including hydrological, agronomic, and landscape-based interventions;
3. Identify priority geographic zones and entry points where targeted, multi-sectoral actions can deliver the greatest impact;
4. Provide strategic insights to guide the SW&FS multi-annual action plan, ensuring alignment with national strategies, partner initiatives, and climate-resilient development goals.

Through this structured assessment, the study offers a holistic understanding of Senegal's salinity challenge and the pathways through which coordinated action can enhance agricultural resilience and food system sustainability.

2. Analytical framework and methods

The salinity scoping study adopted an integrated analytical framework combining desk-based evidence synthesis and stakeholder engagement. This mixed-methods approach was designed to capture the biophysical, institutional, and socio-economic dimensions of salinity in Senegal, while remaining proportionate to the objectives of a rapid scoping exercise intended to inform a multi-annual action plan under the SW&FS partnership's country approach. The framework explicitly recognizes salinity as a systemic challenge shaped by interactions between water management, soil processes, land use, climate variability, and governance arrangements. Accordingly, methods were selected to ensure coherence across scales from national patterns to local processes and across knowledge systems, including scientific evidence, institutional experience, and stakeholder perceptions.

2.1. Desk review approach and evidence criteria

The desk review formed the backbone of the scoping study and aimed to consolidate existing knowledge while avoiding duplication of ongoing analytical work. The review covered four main categories of sources:

- **National and institutional (policy) reports** on soil salinity, land degradation, water management, and climate change;
- **Peer-reviewed scientific literature** on salinization processes, irrigation and drainage systems, groundwater dynamics, and coastal and estuarine systems in Senegal and comparable West African contexts;

- **Project documents and evaluations** from major national and donor-funded programs addressing salinity and land restoration (e.g., PAPIL, PARETS, PADERCA, P2RS, SAGA);
- **Academic research outputs**, including a detailed doctoral thesis on salinity processes and hydraulic governance in the Senegal River Delta, used to strengthen mechanistic understanding at field scale.

2.2. Stakeholder engagement: sampling and tools

Stakeholder engagement was conducted to complement the desk review by capturing practical experience, institutional perspectives, and local knowledge that are often underrepresented in formal literature. Given the rapid nature of the scoping study, engagement focused on key informants rather than statistically representative sampling. Stakeholders were purposively selected to reflect diversity across:

- **Institutional mandates** (research, extension, water management, environment, policy);
- **Geographic exposure** to salinity (Delta, Sine-Saloum, Casamance, Niayes);
- **Levels of action**, including national institutions, regional technical services, development projects, and community-based actors.

Typical stakeholder categories included: National research (ISRA, AfricaRice, INP); Agricultural advisory and irrigation management services (SAED, ANCAR); Development project implementers and NGOs; Local technicians, producer organizations, and community leaders in salinity-affected areas. The information was collected using semi-structured interviews, guided by thematic checklists covering salinity drivers, impacts, responses, and perceived gaps.

3. Salinity in Senegal: spatial distribution, drivers and typology

Salinity in Senegal is spatially heterogeneous and multi-causal. It reflects (i) long-term coastal–deltaic geomorphological inheritance (saline parent materials and shallow saline groundwater), (ii) contemporary hydro-climatic forcing (rainfall deficits, high evaporative demand, estuarine salt intrusion), and (iii) management-induced processes (irrigation expansion without effective drainage, hydraulic discontinuities, and infrastructure maintenance challenges). Salinity is widely recognized as one of Senegal's most pervasive forms of soil degradation. According to the 2012 world bank report, around 645 000 ha of agricultural lands in Senegal are affected by salinity, which correspond to about 6.8% of 9.5 million ha of the national agricultural land (World Bank, 2012). In assessing the severity of salinity stress in the Senegal River Valley, Dumas *et al.* (2010), estimated the saline soils to approximately 179,765 ha representing more than 74% of the potential of irrigated land (240,000 ha). A study in Senegal by van Oort (2018) estimated areas of rice cultivated on saline soils from 7% to 15%, depending the data sources used for the estimations. In another study, Sow *et al.* (2016), estimated the cost of salinization in irrigated rice to US$ 22 million representing 0.2% GDP in Senegal for a total area of 28,366 ha affected by salinity. Even though there are some disparities in the estimated areas affected by salinity from the reviewed reports which generally is attributed to the approaches used, the current estimations provide an idea of the severity of soil salinity in Senegal. The salt-affected landscapes are not uniformly distributed: the Senegal River Delta and estuary, Casamance, parts of the Niayes, and the Fatick–Kaolack (Sine–Saloum) axis are repeatedly identified as major hotspots linked to marine/estuarine influence and hydro-climatic stressors (Table 1).

3.1. Hotspots and typology of salinity situations

3.1.1. Salinity hotspots

The most prominent salinity hotspots are clustered along Senegal's estuaries, deltas and coastal aquifers, and in specific irrigated schemes. A national synthesis identifies major affected zones including the Senegal River Delta/Valley, Casamance, the Niayes (horticulture), and the Fatick–Kaolack/Sine–Saloum estuarine zone (Diam et al, 2022). For the scoping study, it is useful to treat "hotspots" as systems rather than administrative areas:

- **Irrigated delta/valley systems** (Senegal River Valley): salinity in soils and irrigation water linked to shallow saline groundwater and drainage constraints.
- **Estuarine lowlands and mangrove-derived bas-fonds** (Casamance; Sine–Saloum): salinity often coupled with acid sulfate processes.
- **Coastal aquifers and horticultural belts** (Niayes; Gandiolais): salinization of shallow groundwater used for irrigation.
- **Inland degradation interface** (non-estuarine, mixed drivers)

Table 1. Salinity hotspots systems in Senegal

Hotspot system	Main zones affected	Regions covered	Estimated area/ severity	Key characteristics/ typology
1) Irrigated delta/valley systems (Senegal River Valley)	Senegal River Delta; downstream of Richard Toll to the coast; Gorom–Lampsar axis	Saint-Louis	1,700 km² on Senegalese bank; local salinity up to 66%	Strategic irrigated rice zone; salinity in soils and irrigation water; strong role of irrigation-induced salinity and drainage constraints
2) Estuarine lowlands and mangrove-derived bas-fonds (Casamance;	Fossil valley of Sine (Niakhar), Loul Sessène, Sine–Saloum estuary; Mlomp, Oussouye, Bignona marigots,	Fatick, Kaolack, Ziguinchor, Sédhiou	Fatick: 224,441 ha (33% of regional land; ~50% arable); land loss 35–45% in some communes. Ziguinchor: ~600,000 ha; salinity	National hotspot complex; estuarine intrusion + strong salinity–acidity interactions (acid sulfate risks in lowlands); major

Sine–Saloum)	coastal lowlands; rice valleys and Casamance river corridor; Saloum estuary rural communes		36–53%. Sédhiou: 26–37%. Kaolack: ~20%	impacts on rice valleys and lowland farming systems
3) Coastal aquifers and horticultural belts (Niayes; Gandiolais)	Darou Khoudoss; coastal Niayes horticultural belt; (Gandiolais as related coastal aquifer system)	Thiès (Niayes)	~9% salinity in Niayes lands	Groundwater salinization and irrigation-water quality decline; high economic exposure due to horticulture and dry-season water dependence
4) Inland degradation interface (non-estuarine, mixed drivers) *(secondary system class)*	Central agricultural zones; agro-pastoral inland zones	Diourbel; Kédougou, Kolda, Tambacounda	Diourbel: ~20% salinity. Kedougou/Kolda/Tambacounda: 26–37%	Likely linked to aridification and broader land degradation; requires careful diagnosis to separate true salinity from other constraints and to target restoration pathways

3.1.2. Typology of salinity situation

For scoping and intervention design, salinity in Senegal can be classified into five dominants, often overlapping hydro-pedological settings defined by their salt source, transport pathway, and management leverage points (Table 2). First, primary (inherited) deltaic salinity reflects legacy marine transgressions and deltaic deposits that store salts in soils and shallow aquifers; where water tables are shallow and drainage is constrained, capillary rise drives recurrent surface salinization (Sène *et al.*, 1999; Diam *et al.*, 2022). Second, estuarine intrusion salinity is controlled by the balance of tidal forcing and freshwater discharge; reduced flows promote upstream migration of the saline front and seasonal gradients, with documented regime shifts in the lower delta/Gandiolais following hydrological changes (Niang & Descroix, 2015, in Saleem *et al.*, 2015). Third, secondary (management-induced) salinization develops in irrigated schemes when irrigation raises water tables and mobilizes salts but drainage and maintenance are insufficient to export them (Diam *et al.*, 2022). Fourth, salinity–acidity complexes in mangrove-derived lowlands (Casamance, parts of Sine–Saloum) combine saline intrusion with acid sulfate processes; oxidation of sulfidic layers can generate very low pH and strong nutrient constraints, requiring integrated salt and acidity management (Sané *et al.*, 2025). Fifth, coastal aquifer/irrigation-water salinization arises in porous coastal systems where seawater–

groundwater exchange increases the salinity of water used for irrigation (Saleem *et al.*, 2015). Empirical evidence from Casamance rice valleys (EC ~30–9000 µS/cm) highlights strong downstream–upstream gradients, reinforcing the need for spatially targeted interventions (Sané *et al.*, 2025).

Table 2. Types of salinity

Type	Processes	Typical zones
Marine & estuarine intrusion	Tidal and storm-driven backflow of saline water into river valleys and depressions; exacerbated by sea-level rise and mangrove degradation	Sine-Saloum (Fatick, Kaolack), Casamance estuary, lower Senegal River
Primary (inherited) deltaic salinity	Reflects legacy marine transgressions and deltaic deposits that store salts in soils and shallow aquifers; where water tables are shallow and drainage is constrained, capillary rise drives recurrent surface salinization	Delta of Senegal River Valley
Irrigation-induced (secondary) salinity	Poorly drained irrigation schemes; rise of shallow saline groundwater; capillary rise and salt accumulation in root zone	Senegal River Delta (PIV, PIP systems), some irrigated lowlands inland
Saline–acidic and acid sulfate soils	Oxidation of sulfidic horizons upon drainage and field abandonment; combined acidity and salinity constraints	Casamance, parts of Fatick and Sine-Saloum
Groundwater salinization	Over-pumping of coastal aquifers; seawater intrusion; concentration of salts in shallow aquifers	Niayes horticultural corridor, some coastal peri-urban zones

3.2. Biophysical drivers

Salinisation in Senegal is reinforced by a tight coupling of climate, hydrogeology and landscape form. In Sahelian conditions of Senegal, shortened rainy seasons and high evaporative demand intensify upward capillary rise where the water table is shallow, bringing salts to the root zone and ultimately the surface (Diouf, 2020; Amadou *et al.*, 2022). This mechanism becomes particularly damaging in irrigated or low-lying environments when salt leaching is not matched by adequate drainage: salts accumulate at depth and reappear at the surface through capillary recycling, making drainage a central biophysical "control point" for sustainable land use (Amadou *et al.*, 2022). Sea-level rise further accelerates saline intrusion (the "salt wedge") into estuaries and coastal aquifers (The New Humanitarian, 2017; IRD, 1991). In the Senegal River Delta, the extremely flat terrain (average slope <0.006‰) severely limits natural gravitational drainage, favouring salt build-up and persistence (Diouf *et al.*, 2022). Coastal forcing further amplifies estuarine and groundwater salinisation through salt-wedge intrusion and seawater encroachment, especially during low-flow periods (FAO, 2006; The New Humanitarian, 2017). In the field, these dynamics are commonly expressed as whitish salt efflorescences/crusts, rising soil electrical conductivity, and depending on redox and parent-material conditions co-occurring acidification that narrows feasible agronomic options (Michel *et al.*, 1993; Kouton, 2024).

3.3. Agricultural and management drivers of salinity

Agricultural practices and water-resource management are central drivers of secondary (management-induced) salinization in Senegal's irrigated landscapes. For instance, in rice-based schemes, intensification without adequate drainage and water-table control promotes the accumulation of salts in the root zone, as irrigation mobilizes salts while insufficient export pathways (drains, collectors, safe disposal) allow them to recirculate and progressively concentrate in soils (Diouf, 2020; Diouf *et al.*, 2022). This dynamic is particularly evident in Private Irrigated Schemes (PIP) where collective drainage infrastructure is frequently absent or poorly functional, making salinity control dependent on fragmented, plot-level decisions rather than coordinated hydraulic management (Diouf, 2020). The progressive withdrawal of the decision makers from scheme management combined with limited technical backstopping has reinforced individualized practices that are rarely sufficient to maintain long-term water and salt balances across entire perimeters (Diouf, 2020; Dia, 2012). Moreover, when irrigation relies on water of elevated salinity, excessive applications can accelerate chemical degradation, compounding the drainage deficit and further reducing system resilience (Diouf *et al.*, 2022).

4. Impacts on farming systems and food security

4.1. Productivity and yield stability

Soil salinity is among the most yield-limiting stresses for irrigated rice in the Senegal River Valley (SRV), with clear impacts on both average productivity and year-to-year yield stability (Asch *et al.*, 1999; Bado *et al.*, 2015; Djaman *et al.*, 2019). Quantitative field evidence indicates sharp yield penalties once salinity exceeds relatively low thresholds: under soils with EC > 2 dS m^{-1}**,** rice yield losses of up to 1 t ha^{-1} per unit EC (mS cm^{-1}) have been recorded, reflecting strong sensitivity of yield formation to salt stress (Asch & Wopereis, 2001). Yield reduction is strongly cultivar-dependent; under SRV conditions, salinity has been reported to reduce yields by 40–90% depending on varietal susceptibility (Asch *et al.*, 2000). Beyond mean yield loss, salinity drives instability through typical symptoms and failure pathways reduced plant vigor, leaf burn, increased sterility/empty grains, and in severe cases field abandonment thereby undermining farm profitability and food sovereignty (Diouf, 2020; Kouton, 2024; AfricaRice & MetaMeta, 2024).

Management and land use modulate salinity exposure and thus yield stability. In the SRV, soil salinity was shown to be closely related to land use: double-cropped rice fields (two rice crops per year) on drained surfaces were significantly less saline than nearby single-cropped fields, attributed to reduced opportunities for upward salt transport from the saline groundwater table

(Ceuppens *et al.*, 1997). Complementary interpretation emphasized the protective role of the ponded water layer during rice cultivation, which can suppress capillary rise from shallow, highly saline groundwater (Wopereis *et al.*, 1998). However, recent observations suggest that salinity can still intensify even under double cropping, likely due to strong evaporative concentration and persistent saline sources, leading to abandonment of some fields after only a few years (Gning *et al.*, 2017). This evidence indicates that intensification can buffer salinity only when hydraulic performance is adequate and evaporative amplification is managed.

A range of approaches has been tested to maintain yields under salinity, broadly grouped into hydraulic**,** agronomic/nutrient, and genetic strategies. Hydraulic measures aim to ensure good-quality water supply and removal of saline water and dissolved salts. In the SRV Delta, puddling followed by surface drainage removed on average 4.3 Mg salt ha^{-1}**,** compared with 1 Mg salt ha^{-1} per flushing without puddling, and repetitive puddling plus drainage effectively reduced salts in the profile (Haefele *et al.*, 1999). Continuous rice cropping combined with leaching has also been reported to reduce soil salt concentration (Diack *et al.*, 2015). Yet, hydraulic effectiveness is often constrained by low soil hydraulic conductivity and insufficient subsoil drainage, which restrict leaching and promote rapid salt re-accumulation (Haefele *et al.*, 1999; Hammecker *et al.*, 2003). These options are also water- and infrastructure-intensive, increasing costs and limiting feasibility for many farmers (Diop, 2009), while over-irrigation can raise shallow groundwater levels and accelerate post-evaporation salt rebound (Seo *et al.*, 2018). Where drainage and land leveling are properly implemented (e.g., large-scale operators), flushing/drainage can be operationally viable, but most public village schemes lack adequate drainage provisions, constraining adoption (Diack *et al.*, 2015).

Agronomic and genetic options therefore remain essential for stabilizing yields under real-world constraints (Ibrahim *et al.*, 2025). Agronomic measures that reduce salt injury or improve crop tolerance include raised beds, optimized nutrient supply (notably N and K), and residue mulching (Dong *et al.*, 2008; Pang, 1999; Egamberdiev, 2007; Bakker *et al.*, 2010; Bezborodov *et al.*, 2010). In the SRV, salt-tolerant varieties alone or combined with improved nutrient management have shown consistent promise (Bado *et al.*, 2015; Djaman *et al.*, 2019; Mel *et al.*, 2019, Ibrahim *et al.*, 2025). Under seasonal salinity, tolerant cultivars reduced the yield-loss slope relative to susceptible ones (Asch & Wopereis, 2001), and targeted genotype evaluation identified lines with improved tolerance and yield stability indices under Delta conditions (Djaman *et al.*, 2019; Bado *et al.*, 2015). Nutrient and amendment strategies can further improve performance: split N at panicle initiation and booting increased yields under salinity (Djaman *et al.*, 2019), while Zn fertilization increased yields by 7–42% and gypsum by 17–52% relative to zero-Zn or no-gypsum options in tested genotypes (Bado *et al.*, 2015). Integrated packages (e.g., NPK + gypsum or NPK + Zn) have been recommended for saline soils (Ibrahim *et al.*, 2025), consistent with earlier guidance that salt-tolerant varieties combined with appropriate nutrient management are key under SRV's high evaporative conditions and seawater influence (WARDA, 2002). Overall, improving productivity and yield stability under SRV salinity requires integrated management matching salt-tolerant varieties with optimized, balanced nutrition and feasible water/field management implemented and validated under farmers' conditions (Asch & Wopereis, 2001; Djaman *et al.*, 2019; Mel *et al.*, 2019, Ibrahim *et al.*, 2025).

4.2. Water quality and broader system impacts

Beyond soils, salinity-related degradation in Senegal has a clear water-quality and broader system footprint, operating through (i) altered salinity regimes and hydrological functioning following major river regulation works and (ii) the discharge of saline, nutrient- and chemical-enriched return flows from irrigated agriculture. In the Senegal River Delta, regulated flows upstream of the Diama anti-salt dam sustain Lake Guiers**,** a strategic freshwater reserve for drinking-water supply and irrigation; however, the system is increasingly exposed to pollution pressures and hydraulic dysfunction (World Bank, 2022). A 2019 baseline for Lake Guiers reported the occurrence of around 30 pesticide compounds**,** 10 heavy metals, and bacteriological contamination (including *E. coli* and *Salmonella*) above potability standards, with agro-industrial and irrigated drainage discharges identified among major sources (World Bank, 2022). These loads contribute to eutrophication and aquatic macrophyte proliferation, which reduces conveyance capacity, constrains multi-use access to waterways, and affects fisheries and disease-risk profiles; aquatic vegetation was reported to impact approximately 30% of Lake Guiers (World Bank, 2022). At the same time, the regulation of seasonal flows (including by Organisation pour la Mise en Valeur du fleuve Sénégal infrastructure such as Diama and Manantali) has reshaped wetland dynamics, with documented ecological externalities that must be considered alongside salinity control benefits (World Bank, 2022; Diouf, 2020). In southern estuarine systems (notably Casamance), salinity control relies more on anti-salt micro-dams designed to block marine intrusion, retain freshwater and enable gradual desalinisation of rice lowlands (Montoroi, 1994). Early assessments also reported ecological responses, including changes in fish assemblages, underscoring that salinity-control interventions should be assessed as integrated soil–water–ecosystem measures rather than plot-scale solutions alone (Le Reste, 1986).

4.3. Vulnerability and livelihood implications

The socio-economic implications of salinity are profound and extend well beyond agronomic yield penalties. In Senegal's most affected deltas and estuarine lowlands, hyper-salinisation can render fields unproductive and ultimately force land abandonment, shrinking the effective land base and increasing competition and pressure on the remaining cultivable areas (Diouf, 2020). This degradation of productive assets directly undermines household income, heightens rural poverty, and is frequently cited as a strong driver of youth out-migration to urban centres or abroad (Diouf, 2020). Vulnerability is also socially differentiated: smallholders often operating with limited capital, weak access to drainage or soil amendments, and higher exposure to production risk have fewer options to absorb shocks or invest in rehabilitation (Diatta *et al.*, 2022). For instance, in coastal rice systems such as Casamance, where women play a central role in rice production and post-harvest activities, gendered constraints (limited control over land, credit, inputs, and mechanisation services) can further reduce adaptive capacity and deepen inequities under salinity stress (Diatta *et al.*, 2022; Camille *et al.*, 2023). Finally, salinity-driven changes in water management and hydrological regimes particularly the persistence or stagnation of modified freshwater bodies may create favourable conditions for water-related diseases such as schistosomiasis, adding a public-health burden to already vulnerable farming communities (Diouf, 2020).

5. Review of current responses and performance

5.1. Existing programs/interventions and evidence

In response to widespread salinity impacts, the Government of Senegal and its partners have implemented a portfolio of policy and field interventions, although the overall response remains more programmatic than governed by a single dedicated operational framework (Table 3). Salinity is acknowledged in national adaptation and sector strategies, including the National Adaptation Programme of Action (PANA), yet Djibo Ka (2013) notes that this recognition has not consistently translated into a unified, results-based implementation architecture. On the ground, evidence from major programs indicates that hydraulic and watershed interventions have been the most frequently deployed pathway, notably through construction of anti-salt structures, valley rehabilitation and drainage. The PAPIL program (2003–2015) is reported to have supported the construction of 58 anti-salt structures and the recovery of 3,710 ha of salt-affected land (Djibo Ka, 2013), while more detailed implementation reporting for Fatick indicates 6,983 ha recovered and 11,500 ha protected, alongside substantial complementary investments in rural social infrastructure and farmer training (Djibo Ka, 2013). In Casamance, PADERCA is reported to have developed drainage systems across 71 valleys and supported the protection/restoration of large lowland areas through engineered dikes and gated structures designed to stop salt-water intrusion and facilitate soil leaching (Djibo Ka, 2013). Beyond infrastructure, state agencies such as SAED have provided technical support in the Senegal River Valley and promoted soil rehabilitation options such as phosphogypsum-based amendment to address sodicity-related constraints in irrigated schemes (Diouf, 2020). More recent initiatives including research–action projects supported by international partners are emerging, reflecting growing interest in integrated approaches that combine biophysical diagnostics, community-level governance and scalable restoration practices (UNESCO, 2024; FAO, 2025). Overall, the evidence suggests measurable local gains in reclaimed/protected land and capacity development, but also highlights the need for sustained maintenance, stronger coordination and more explicit monitoring of agronomic and livelihood outcomes across intervention types (Djibo Ka, 2013; Diouf, 2020).

Table 3. Existing programs/interventions and evidence

Period/status	Region/ hotspot cluster	Program/project	Core intervention package	Reported outputs/ outcomes
Ongoing (2018–present)	Fatick (Sine–Saloum)	PARETS (Projet pour la Résilience des Écosystèmes)	Anti-salt dams; valley development for rice; reforestation (IUCN as implementing partner)	Loul Sessène reported as a “mirror learning commune” for good practices
Ongoing (2018–present)	Fatick (Sine–Saloum)	IPAR & partners	Field-level protective bunds/dikes; blocking seawater entry into cultivated soils; combination of mechanical + traditional measures	Integrated mechanical + traditional control options implemented
Ongoing (2018–present)	Kaolack (Saloum / Groundnut basin interface)	SAGA (Sécurité Alimentaire: Agriculture Adaptée)	Soil Health Advisory Clubs (CCSS); agronomist training; promotion of organic amendments; compost production	3 CCSS; 60 producers (incl. 32 women); reported yield gains (e.g., +5 quintals groundnut in year 1)
Ongoing (2018–present)	Thiès (Niayes)	SAGA	CCSS; agroforestry; planting of halophytic woody species	Improved soil fertility in horticultural zones (as reported)
Ongoing (2018–present)	Diourbel (Groundnut basin)	SAGA	CCSS; soil diagnosis training; composting; fertilization planning	Capacity strengthening and knowledge transfer (as reported)
2024	SRV	ISSM4RICE: Integrated Soil Salinity Management in RICE-based cropping systems in the delta of Senegal River Valley”	Raise awareness and strengthen capacity on cost-effective farm solutions for salinity	Integrated Soil Salinity Management in RICE-based cropping systems in the delta of Senegal River Valley (ISSM4RICE) - Saline Agri Map

Table 3. Existing programs/interventions and evidence (continued)

2024- present	Niayes	Impact cluster Horti Senegal	improve the vegetable production of safe and tasty vegetables for the Senegalese market by increasing the competences of young smallholder farmers in the Niayes region (Kirene and St. Louis) and reducing environmental impact.	Impact Cluster: Horti Senegal | Project Database CMS
2024-present	Kayar	Onions Farming for the Future	Improve onion production under saline conditions. This project is implemented in Kayar and, through crop rotation	https://www.hortibusiness-senegal.com/project/
2022-2023 (completed)	Fatick region	Contribution to the restoration of land affected by salinization in the locality of Djilor for a sustainable agriculture (Fatick Region)	Boost agricultural production through the regeneration of soils affected by land salinization by integrating better water and soil management and through land fertilization.	Contribution to the restoration of land affected by salinization in the locality of Djilor for a sustainable agriculture (Fatick Region) | Climate Chance
2021-2022	Casamance	Strengthening education on climate smart and saline agriculture by training teachers to enhance food security in Casamance, Senegal	Improve yields during the dry season, using common annual crops such as carrots and onions and apply different treatments such as mulching and compost applications.	Senegal | The Salt Doctors

2007-2018	Regional program	Stress-Tolerant Rice for Africa and South Asia (STRASA)	develop and deliver rice varieties that are tolerant to abiotic stresses for the millions of farmers in rainfed rice-growing environments in Asia and Africa.	STRASA Legacy site - About us
2015–2020 (completed)	Ziguinchor (Casamance)	P2RS (Programme de Renforcement de la Résilience)	17 small water-mobilisation works; anti-salt dikes (e.g., 1,516 m at Boukitingho); land development; market gardens; reforestation; nutrition/youth actions	1,382 ha protected and under use; 1,979 ha developed; 331 ha market gardens; 724 ha reforested; 98,000 children reached; 451 youth employed; budget US$35.8M
2011-2025	Regiona Program	Improving Crop and Seed Production Systems under Water/Irrigation Management in Sub-Saharan Africa	Improve the performance of different production systems related to water availability and quality, soil and crop sustainability, water nutrient management practices and socioeconomics in Sub-Saharan Africa.	Improving Crop and Seed Production Systems under Sustainable Water/Irrigation Management in Sub-Saharan Africa | International Center for Biosaline Agriculture
2006–2014 (completed)	Ziguinchor (Casamance)	PADERCA (Projet d'Appui au Développement Rural en Casamance)	35 valleys developed; anti-salt dikes; reinforced concrete gated works for leaching; social infrastructure	14,000 ha protected; social infrastructures (classrooms, health posts)
2006–2014 (completed)	Sédhiou (Casamance corridor)	PADERCA	Similar package to Ziguinchor (valley rehabilitation, anti-salt works)	Restoration/valorisation of natural resources (as reported)
2003–2015 (completed)	Fatick (Sine–Saloum)	PAPIL (Projet d'Appui à la Petite Irrigation Locale)	58 anti-salt structures; land reclamation; protection against	6,983 ha reclaimed and 11,500 ha protected; 11,000 farmers

			saline wedge; plus socio-economic infrastructure	trained; 223 socio-economic infrastructures
2003–2015 (completed)	Kaolack	PAPIL	Anti-salt works and hydro-agricultural development	Areas protected against salinisation (as reported)
2003–2015 (completed)	Kédougou, Kolda, Tambacounda	PAPIL	Anti-salt structures; hydro-agricultural development; social infrastructure	Land reclamation and capacity strengthening (as reported)
2000–2015 (completed)	Thiès (Niayes)	Other projects (PROGERT; PGIES)	Demonstrations of land recoverability and rehabilitation options	Demonstration evidence of recoverability (as reported)
1990s–present (ongoing)	Ziguinchor (Casamance)	ANCAR (Conseil agricole)	Earth dikes compacted and vegetated (andropogon, panicum, vetiver) with gated outlets; ridge/bund shaping for leaching; small dams	Reported rice yields ~1.0–1.5 t/ha; ~50 small dams constructed in the 1990s
1980–2010 (completed / mixed outcomes)	Ziguinchor (Casamance)	Historical projects (PIDAC/SOMIVAC, DERBAC, PROGES, PRODULAS, PROCAS, PPDC)	Supporting/rehabilitation developments	Results described as mixed, affected by conflict context

5.2. Technology and practice options and their suitability for salinity management

In Senegal, farmers and local organizations increasingly implement agroecological and nature-based salinity management that combines salt exclusion and water control (community anti salt dikes, bunds, and canal maintenance) with drainage and controlled flushing to export salts from the root zone (Albergel et al., 1992; Montoroi, 1995; Raes et al., 1995). These hydraulic measures are increasingly complemented by organic matter-based soil rehabilitation and farmer managed natural regeneration and agroforestry, which improve infiltration, reduce evaporative salt rise, and strengthen soil functions and resilience (Winterbottom et al., 2020). Technology and practice options for managing salinity in Senegal are most effective when they are matched to the dominant salinity process (estuarine intrusion, shallow saline groundwater, irrigation-induced salinity) and implemented with feasible maintenance arrangements. Farmers have developed a wide repertoire of locally adapted strategies, including artisanal anti-salt dikes (stone/earth), heavy application of compost and crop residues to improve soil structure and buffering capacity, adoption of halotolerant rice varieties (e.g., ISRIZ 10, ISRIZ 11), and rotations with less salt-sensitive crops (Ibrahim *et al.*, 2025; Diatta *et al.*, 2022; Thiam *et al.*, 2019; Voré Gana *et al.*, 2015; GRDR, 2008). In the Senegal River Delta, farmers also practice immersion/leaching and maintain a ponded water layer in rice fields to reduce capillary salt rise, reflecting practical hydrological control under shallow saline groundwater conditions (Diouf, 2020). Decision-making is frequently guided by vernacular indicators (soil color, taste of water, and vegetation condition) used to diagnose salinity severity and adjust management accordingly (Diouf *et al.*, 2022). Evidence from the Sine–Saloum coastal agricultural landscape (Djilor, Fatick) further shows that common coping measures include chemical fertilization and tree planting/conservation, organic manure inputs and soil bunds, complemented by fallow, mulching, and adoption of tolerant varieties (Thiam *et al.*, 2019). In Casamance rice valleys, surveyed households reported strong reliance on embankments, together with organic amendments and ridging/billonnage but also highlighted maintenance and resource constraints that can limit performance over time (Diatta *et al.*, 2022). Finally, field experience indicates that anti-salt micro-dams can protect lowlands and enable progressive desalinization only when coupled with controlled freshwater circulation and releases that export dissolved salts while maintaining water levels compatible with rice calendars (Montoroi, 1994).

5.3. Priority management actions for salinity hotspot systems in Senegal

The table summarizes Senegal's main salinity hotspot systems and translates their dominant drivers into a phased response plan, distinguishing immediate priorities (0–12 months) from medium-term actions (2–10 years) and specifying a fit-for-purpose monitoring framework. The recommended actions explicitly include desalinization measures (controlled leaching/flushing with adequate salt evacuation), rehabilitation of salt-affected soils (drainage rehabilitation/expansion, soil-structure improvement, calcium and organic amendments, and management of seawater intrusion and irrigation/groundwater quality), and system-appropriate salinity monitoring. Monitoring is tailored to each hotspot and focuses on standardized indicators, including soil salinity, irrigation or groundwater salinity, groundwater depth in irrigated and coastal aquifer systems, and soil pH in lowlands with potential acid sulfate risks, complemented by rehabilitated area and crop yields to track impact and support adaptive management.

Table 4. Salinity hotspots in Senegal: priority actions and monitoring indicators

Hotspot system	Priority actions (0–12 months)	Priority actions (2–10 years)	Key indicators (units)
1) Irrigated delta/valley systems (Senegal River Valley – Saint-Louis)	Map soil ECe, irrigation ECw and water table depth. Clean drains/gates; level plots; repair bunds. Implement flushing/leaching; prevent recirculation of saline drainage water. Apply balanced nutrients (split N; add K/Zn where needed); deploy salt-tolerant varieties in worst blocks.	Upgrade drainage (collectors/tertiaries; targeted subsurface drains). implement multi-year desalinization + evacuation program; Apply water-quality rules (EC thresholds, blending, scheduling). Scale safe AWD where feasible; rehabilitate salinized soils finance and enforce O&M for drains/gates.	Soil ECe (dS m-1, 0–20 cm) Irrigation ECw (dS m-1) Water table depth (m) Paddy yield (t ha-1) Functional drains (%)
2) Estuarine lowlands and mangrove bas-fonds (Casamance; Sine–Saloum)	Repair bund breaches; restore basic sluice operation. Desilt/clean canals to enable freshwater flushing. Screen acidity risk (soil pH); avoid over-drainage in sensitive bas-fonds. Promote tolerant rice and adjusted calendars; strengthen valley committees for maintenance.	Construct durable anti-salt dikes and gated structures. Restore valley hydrology (controlled flushing; safeguarded micro-drainage). Apply lime and organic amendments where acidity is confirmed; rehabilitate salinized irrigated soils formalize O&M financing and rules.	Canal EC (dS m-1) Soil ECe (dS m-1) Soil pH (1:2.5) Functional gates (%) Area recovered (ha)
3) Coastal aquifers and horticultural belts (Niayes; Gandiolais)	Monitor well ECw and set user thresholds/alerts. Adopt efficient irrigation (drip, scheduling) and mulching to reduce salt build-up. Map pumping hotspots; protect recharge zones; promote blending/conjunctive use where possible.	Implement groundwater governance (quotas, well spacing, seasonal limits). Pilot managed aquifer recharge where feasible. rehabilitate salinized horticultural soils Scale soil salinity mitigation (raised beds; leaching only with drainage) and shared monitoring.	Well ECw (dS m-1) Groundwater level (m) Pumping volume (m3 season-1) Soil ECe (dS m-1) Yield/quality loss (%)
4) Inland degradation interface (mixed drivers) (Diourbel; Kedougou; Kolda; Tambacounda)	Confirm diagnosis (ECe, pH; ESP/SAR if available) and map landscape positions. Restore infiltration (bunds, demi-lunes/zaï) and reduce runoff. Increase organic inputs and ground cover; promote RNA/agroforestry.	Scale integrated rehabilitation (landscape + fertility); desalinize/leach only where hydrology allows strengthen ISFM extension; fine mapping of salinity vs other constraints, Scale landscape restoration and erosion control; develop local risk maps and decision rules.	Soil ECe (dS m-1) Soil pH (1:2.5) SOC (%), where available Infiltration (mm h-1) Ground cover (%)

5.4. Constraints to performance and scaling

Constraints to performance and scaling of salinity-management options in Senegal are best understood as a combined technical–economic–institutional bottleneck**,** rather than a lack of practices per se. First, affordability and sustained financing remain decisive: chemical amendments are widely used, yet they are frequently judged too costly to apply at effective rates and over multiple seasons, limiting durability and equity of adoption (Diouf *et al.*, 2022). Second, hydraulic constraints strongly condition outcomes: where collective drainage networks are absent or non-functional, "drainage" can become simple disposal of saline return flows onto neighbouring plots or natural depressions, displacing salinity spatially and generating inequities between upstream and downstream users (Diouf *et al.*, 2022). Third, capacity and information gaps reduce the efficiency of interventions: limited farmer training particularly on the optimal and safe use of amendments such as phosphogypsum combined with weak access to decision-support information (no early-warning system and limited routine monitoring of soil and water salinity) leads to poorly targeted applications and inconsistent results (Diouf *et al.*, 2022; Villamor *et al.*, 2019). Finally, scaling requires collective action and enforceable rules, yet field implementation of normative frameworks such as the Charter of the Irrigated Domain (CDI, 2007) is reported to remain weak, undermining coordinated maintenance, compliance, and scheme-level management that salinity control depends on (Diouf, 2020). Taken together, these constraints imply that successful scaling in Senegal will require integrated packages that couple technologies with operations & maintenance financing**,** functional drainage governance**,** targeted training**,** and a minimal salinity monitoring architecture to support adaptive management (Diouf *et al.*, 2022; Diouf, 2020).

6. Stakeholder and institutional landscape

6.1. Actor mapping and mandates

Salinization governance in Senegal is best understood as an interlinked system of (i) policy and regulation, (ii) hydraulic and land-management operations, (iii) research and technical backstopping, and (iv) local collective action and development delivery**.** At the policy level, the Ministry of Water and Sanitation notably through DGPRE and OLAC works alongside the Ministry of Agriculture and the Ministry for Environment and Sustainable Development to shape priorities, standards, and investment programs; importantly, Senegal's National Strategy & Action Plan for Biodiversity (CBD) explicitly recognizes salinization as a significant driver of biodiversity loss, reinforcing the need for cross-sector coordination beyond agriculture alone. In parallel, salinity dynamics in the Senegal River system are influenced by basin-scale water governance under the OMVS, while operational support for irrigated perimeters has historically been led by SAED, including scheme development and technical supervision in the Senegal River Valley (Dia, 2012). Research and development actors provide the evidence base and scalable solutions: ISRA and

Université Gaston Berger contribute national research capacity; AfricaRice supports technology development and scaling in rice-based systems (notably varietal improvement and integrated soil–water–nutrient management); international partners such as IRD have also contributed to foundational knowledge (IRD, 1991). A core technical institution for soils is the Institut National de Pédologie (INP) whose mandate centers on restoring degraded lands**,** preserving soil resources**,** and increasing land productivity, while strengthening producer capacities for sustainable land management. Finally, implementation and day-to-day functionality depend on local institutions, farmers' organizations (OP), Hydraulic Unions (UH), and water-management committees, including women's associations such as *Sakh Diam* often complemented by NGOs and international organizations (e.g., GRDR, WWF) that support community facilitation and project delivery (Diouf, 2020; Diouf *et al.*, 2022).

6.2. Coordination bottlenecks and opportunities

Coordination bottlenecks remain a central constraint to effective and scalable salinity management in Senegal because responsibilities are dispersed across water, agriculture, environment, basin governance, research, and local user organizations without a single operational backbone. Senegal-specific analyses highlight a persistent fragmentation of actors and interventions, with no clearly articulated national strategic and operational framework dedicated to salinity management, resulting in project-by-project actions rather than a coherent program with shared targets, indicators, and accountability (Diouf *et al.*, 2022). This fragmentation creates overlaps, geographic gaps, and discontinuities between infrastructure investments (anti-salt works, drainage), agronomic support, and long-term operation and maintenance arrangements, while participatory mechanisms that endure beyond project cycles remain limited (Djibo Ka, 2013). Coordination is further undermined by individualized management logics where drainage decisions can externalize salinity risk to neighbouring plots and by land tenure disputes that weaken incentives for collective investments and long-horizon land restoration (Diouf, 2020). Despite these constraints, the literature identifies several institutional opportunities to shift from fragmented projects to integrated governance. Territorial planning tools such as Plans d'Occupation et d'Affectation des Sols (POAS) can help reduce land-use conflicts and align salinity-control investments with locally negotiated land and water functions, strengthening legitimacy and compliance (Diouf, 2020). Reinforcing local basin committees ("comités de bassin") and multi-stakeholder water platforms can support negotiated rules for water allocation, drainage, maintenance, and shared monitoring of soil and water salinity, thereby improving coordination and sustainability (Diouf *et al.*, 2022; Diouf, 2020). In addition, Senegal's National Strategy & Action Plan for Biodiversity (CBD) which recognizes salinization as a significant driver of biodiversity loss offers a policy entry point to mainstream salinity management across sectors, mobilize environmental co-financing, and strengthen coordination between agricultural restoration goals and wetland/coastal ecosystem conservation priorities.

7. Priority geographies and intervention entry points

7.1. Prioritization logic

An effective salinity response in Senegal requires prioritizing geographies where (i) the severity and dynamics of salinity are highest, (ii) the potential for recovery is demonstrably feasible, and (iii) the livelihood vulnerability of affected communities is greatest. In practice, prioritization should combine a biophysical lens salinity intensity and spatial gradients shaped by hydraulic connectivity (including distance to the main hydraulic axis, exposure to saline wedges, shallow saline groundwater, and drainage bottlenecks) with a socio-economic lens capturing differential capacity to invest in recovery and to sustain collective action (Diouf, 2020; Diouf *et al.*, 2022). Priority should therefore be given to (a) areas with active and accelerating salinity processes (e.g., estuarine intrusion or secondary salinization under irrigation), (b) sites where infrastructure leverage points exist (e.g., drain collectors, gates, anti-salt structures), and (c) communities facing high exposure with limited adaptive resources. From an operational standpoint, Private Irrigated Schemes (PIP) lacking functional collective drainage and fields already abandoned or at immediate risk of abandonment represent high-return targets because they combine severe salinity, clear management leverage, and strong livelihood consequences.

7.2. Priority regions and entry points

Synthesizing Senegal-specific studies highlights three priority salinity landscapes that combine severe biophysical stress with clear operational entry points for recovery and scaling. First, the Senegal River Delta, particularly the Gorom–Lampsar axis, where shallow saline groundwater, flat topography, and drainage constraints intensify salinity risks in strategic irrigated rice areas (Diouf, 2020; Amadou *et al.*, 2022). Second, the rice valleys of Lower Casamance (Ziguinchor–Sédhiou), where salinity is frequently coupled with acidity and where anti-salt infrastructure and valley-scale water governance are central to restoring production (Diatta *et al.*, 2022; Sané *et al.*, 2025). Third, the Sine–Saloum coastal lowlands (Fatick–Kaolack)**,** where estuarine intrusion and livelihood vulnerability intersect with strong land-use pressures (Diouf, 2020; Thiam *et al.*, 2019). Across these priority systems, high-impact entry points include: rehabilitating and extending collective drainage networks and ensuring viable organization and management arrangements; strengthening farmer capacity in irrigation scheduling, salt balance management**,** and safe/efficient amendment use; improving tenure and compliance conditions through tools such as the Charter of the Irrigated Domain (CDI)**;** and scaling context-specific resilient production packages notably salt-tolerant varieties and integrated soil–water–nutrient management in the Delta, and combined salinity–acidity and agroforestry options in estuarine lowlands (Diouf, 2020; Diouf *et al.*, 2022; AfricaRice & MetaMeta, 2024).

8. Stakeholder engagement on salinity in Senegal: key findings and recommendations

Stakeholder engagement confirms that salinity in Senegal is widely perceived as a multi-causal, system-level constraint affecting production, water resources, and livelihoods, and that progress is constrained less by a lack of "solutions" than by coordination, maintenance, and operational decision-support gaps. Across institutions and user groups, salinity is consistently described as spatially heterogeneous, with "hotspots" that reflect the interaction between inherited deltaic/coastal conditions, contemporary hydro-climatic stress, and management-induced processes (notably irrigation expansion without effective drainage). Stakeholders repeatedly emphasized that salinity impacts are visible, the most frequently reported field indicators are soil colour change and plant death, followed by bitter/salty water taste and white salt crust (Figure 1) and measurable at field level through soil whitening/crusting, patchy crop performance, sterility and yield decline (Figure 2) and that these symptoms often co-occur with broader hydraulic dysfunction and constraints on water quality.

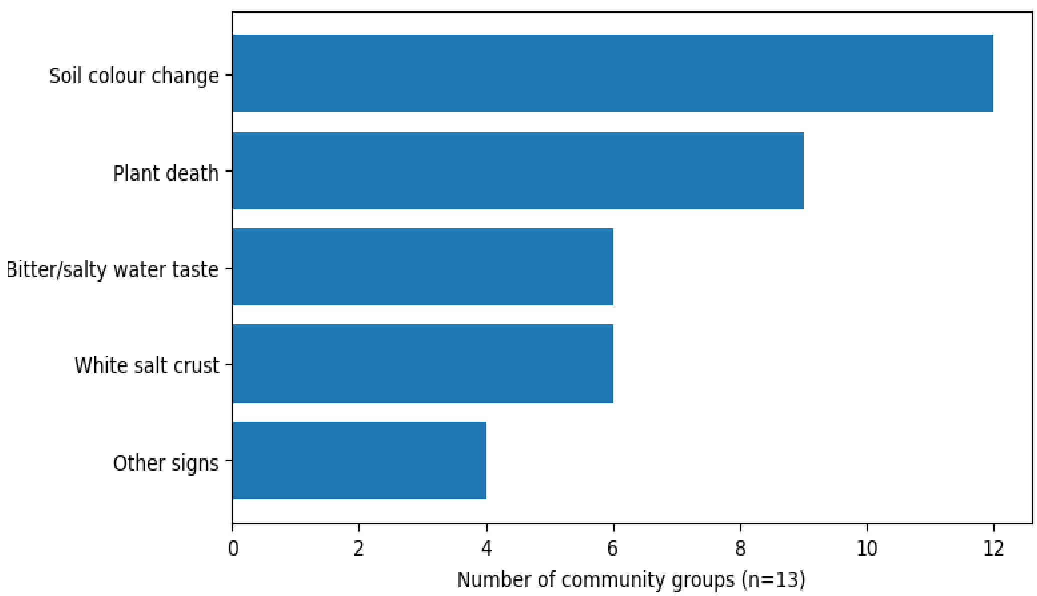

Figure 1. How communities recognize salinity

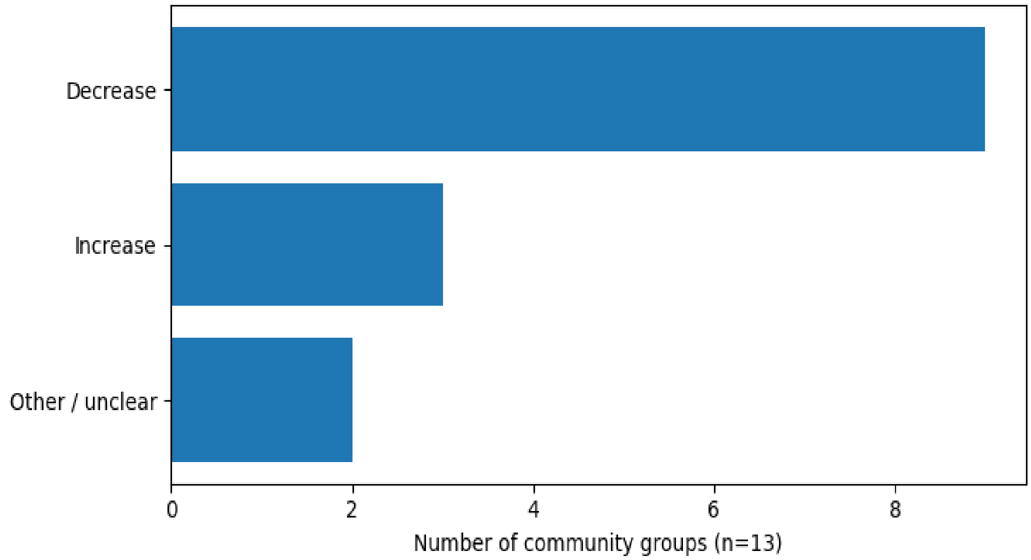

Figure 2. Yield trend observed over the past 5 years reported by stakeholders

8.1. Key findings from stakeholders

8.1.1. Salinity is understood as a coupled soil–water problem requiring collective solutions

Government and technical actors emphasize that salinity persists where shallow saline groundwater, capillary rise, and poor evacuation of salts combine with inadequate drainage performance. Community stakeholders confirm that farmers largely respond by trying to move salts away through washing/flushing and local drainage (Figure 3), which implicitly treats salinity as a water-management problem rather than only a soil-fertility issue.

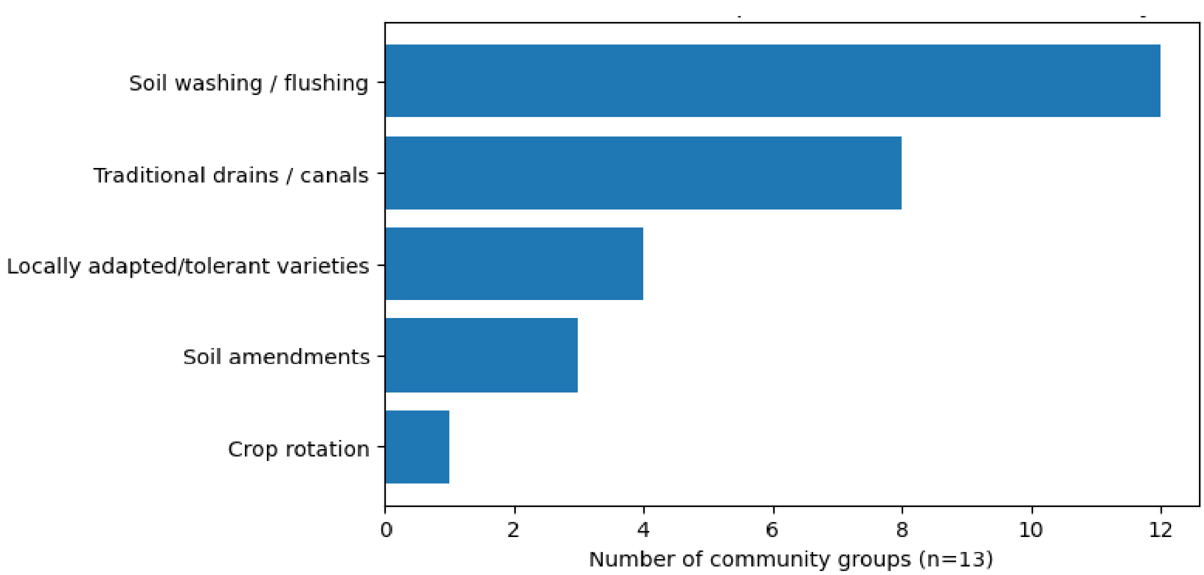

Figure 3. Current practices for salinity management

8.1.2. Constraints to effective salinity management and scaling

Stakeholders consistently identify three binding constraints that limit the effectiveness and scaling of salinity management in Senegal. First, monitoring and decision support remain insufficient: salinity tracking is largely confined to biannual EC monitoring by hydraulic services, while most institutions and producers lack accessible tools, data, and practical training to translate diagnostics into timely field actions. Second, coordination across mandates is weak: linkages among SAED, the Ministry of Agriculture, Hydraulics services, and research institutions are often informal, and existing support measures (e.g., lime/phosphate subsidies) are not consistently embedded within a coherent operational strategy further constrained by limited budgets, staffing, and equipment. Third, implementation feasibility at farm level is limited: farmers mainly rely on leaching/traditional drainage and phosphate use, but many report irregular technical backstopping and insufficient access to finance and inputs, which undermines sustained adoption and scheme-level impact.

8.1.3. Drainage and maintenance bottleneck

Community groups most frequently cited soil washing/flushing and traditional canals/drainage as primary practices. These actions can offer short-term relief but are structurally limited where collective drainage outlets are absent or where salinity is continuously replenished by groundwater/estuarine sources. Stakeholders underline that without functioning drainage networks and clear maintenance arrangements, many plot-level measures remain partial or temporary.

8.1.4. Monitoring and diagnostics exist, but are not yet embedded in an operational decision system

The Hydraulique Division reports diagnostic mapping approaches using EC, topography and land use, and indicates seasonal soil salinity monitoring (roughly twice per year), with results shared through an early-warning platform. However, stakeholders also highlight that the “last mile” is missing: monitoring outputs do not consistently translate into an agreed sequence of actions (e.g., thresholds that trigger maintenance, flushing/drainage schedules, or targeted advisory).

8.1.5. Knowledge support is present but unevenly

Training/extension emerges as the most commonly reported form of support, yet several community stakeholders also report no support, and many highlight needs for credit and inputs to implement recommended practices. This mismatch suggests that information alone will not scale solutions without financing mechanisms and delivery pathways adapted to smallholder realities.

8.1.6. Private-sector engagement is possible but requires enabling conditions

Private stakeholders link salinity to reduced performance and economic outcomes and call for improved infrastructure, clearer rules, and financing conditions that make interventions investable. This indicates potential for private participation in input/seed delivery and service provision, but only where the public system can reduce risk through infrastructure functionality and governance clarity.

8.1.7. Research and innovation supply is present—scaling is constrained by transfer, coordination

Research institutions are reported to be developing salt-tolerant materials (ISRIZ lines, Sahel varieties) and testing amendments (lime, organic products) and drainage techniques, but these results struggle to generalize due to weaknesses in technology transfer, institutional coordination, and systematic soil monitoring.

8.2. Strategic implications of the key insights from stakeholders' engagement

The stakeholder evidence points to a central conclusion: salinity management in Senegal must be treated as a system intervention, not a standalone plot technology. The most critical leverage points are (i) restoring the ability of schemes and lowlands to export salts (drainage function, outlets, controlled releases), (ii) translating diagnostics into operational decisions, and (iii) creating sustainable O&M and coordination mechanisms that persist beyond projects.

8.3. Recommendations for action and investment

The following recommendations and interventions provide a coherent, systems-based roadmap for addressing salinity constraints in Senegal's priority production environments, translating the scoping findings into actionable steps with clear accountability and time horizons. They emphasize moving from fragmented, site-by-site responses toward integrated salinity management that combines (i) a minimum viable national monitoring and decision-support capability, (ii) targeted entry packages aligned with distinct salinity "systems" (irrigated schemes, estuarine lowlands, coastal aquifers, and inland mixed-driver zones), (iii) Deploy integrated agroecological salinity management packages tailored to Senegal's salinity systems, and (iv) Strengthen multi-level governance to clarify O&M responsibilities, improve intersectoral coordination, reduce duplication, and enhance accountability and (v) Strategically engage the private sector through de-risked, performance-based service and input delivery partnerships. Together, the short-term actions, next-step milestones, and long-term investments aim to ensure durable desalinization and rehabilitation of salt-affected soils, improved productivity and profitability, and a robust framework for adaptive management based on measurable indicators and coordinated institutional roles.

Table 5. Recommendations for addressing salinity in Senegal

Recommendation	Lead (accountable owner)	Action plan (core implementation)	Next steps	Long-term interventions (3–10 years)
1. Establish a minimum viable salinity intelligence, salinity map and decision-support system	National salinity steering unit (Ministries, SAED, Research, ANCAR, Producer Organizations)	Harmonize core indicators (ECe, ECw, groundwater depth, pH in acid-sulfate risk zones) and field diagnostics; deploy sentinel sites and seasonal surveys; define decision triggers (maintenance, flushing windows, advisory alerts) with accountable roles	Agree SOPs and units; select sentinel sites per system; define trigger thresholds and response actions; pilot a simple dashboard and quarterly bulletin	Establish a national salinity observatory (data governance, open protocols); integrate remote sensing + ground truth for annual salinity maps; embed decision-support into extension platforms; secure stable financing for monitoring and annual reporting
2. Prioritize interventions as salinity systems and match entry points accordingly	SAED (SRV); Local authorities/PO platforms (estuaries); Water resources agencies (coastal aquifers); Research & extension (inland)	Apply typology-based targeting: (a) SRV irrigated schemes—drainage and salt export; (b) estuarine bas-fonds—intrusion control and collective governance; (c) coastal belts—water quality and abstraction; (d) inland—diagnosis and restoration	Validate hotspot/system map; select priority clusters; define system-specific entry packages (infrastructure + rules + advisory)	Develop landscape-scale rehabilitation plans with explicit salt-balance objectives; align salinity zoning with land-use planning, irrigation expansion, and climate adaptation strategies
3. Deploy integrated agroecological salinity management packages tailored to Senegal's salinity systems (Senegal River Valley irrigated schemes, estuarine lowlands Casamance and Sine Saloum, coastal aquifers	ANCAR, SAED for delivery) with AfricaRice and ISRA for technical backstopping	System specific packages that combine: 1) Salt exclusion and water control (bunds, anti-salt dikes, sluice operation rules, canal maintenance) 2) Salt export and soil desalinization where hydrology allows (controlled drainage, targeted flushing, safe discharge timing) 3) Soil rehabilitation to reduce	1) Establish hotspot zoning and select priority clusters in SRV, Casamance, Sine Saloum, Niayes 2) Launch participatory demonstration platforms in each system with farmer led learning 3) Agree on a minimum	1) Institutionalize landscape scale rehabilitation of salt affected soils with durable O and M financing and contractor markets 2) Scale South-South learning hubs for agroecological salinity management and embed curricula in national training institutions 3) Expand monitoring into a national

Niayes, inland mixed driver zones)		evaporative salt rise and improve infiltration (compost, manure, residue cover, reduced soil disturbance, land leveling) 4) Biological regeneration in inland interfaces (FMNR, agroforestry hedges, vegetative strips) 5) Climate smart cropping (salt tolerant varieties, adjusted calendars, diversified rotations	monitoring set 4) Produce simple advisory protocols for water control, flushing windows, organic inputs and variety choice 5) Build capacity of SAED and ANCAR extension agents and water user committees	salinity intelligence system with annual maps and decision support 4) Integrate salinity packages into subsidy and credit systems for tolerant seed, organic inputs and drainage maintenance 5) Mainstream agroecological salinity management into national irrigation design standards, coastal aquifer governance and climate adaptation planning
4. Strengthen multi-level governance to clarify O&M responsibilities, improve intersectoral coordination, reduce duplication, and enhance accountability.	Local water-management platforms and Producer Organizations, supported by SAED and local authorities, under a national steering mechanism involving relevant ministries, agencies, and research institutes.	Clarify mandates for drains, gates, and anti-salt works; establish sustainable O&M financing and seasonal maintenance calendars with compliance mechanisms; and embed these actions within an annual, cross-sector coordination framework that mainstreams salinity into sector plans, clarifies roles from research to extension to adoption, and harmonizes M&E and reporting.	Map existing committees and gaps; adopt standard O&M schedules; pilot performance scorecards; agree conflict-resolution rules; Establish Terms of references and annual workplan; map 'who does what where'; align indicators and the budgeting cycle	Create durable institutions for water control: legal recognition, multi-year O&M contracts, dedicated maintenance funds, and enforcement; professionalize O&M (trained operators, certified contractors); tie budget allocation to maintenance performance; Institutionalize national policy and financing architecture: dedicated budget lines, multi-donor coordination, results-based financing tied to reclaimed area and productivity; integrate salinity into water allocation policies, irrigation design standards, and climate resilience planning

5. Strategically engage the private sector through de-risked, performance-based service and input delivery partnerships	SAED and local authorities, in partnership with Producer Organizations, and supported by relevant line ministries and a PPP facilitation unit	Define “ready zones” where enabling conditions exist (functional drainage outlets, clear operation and maintenance rules, transparent targeting); contract private operators for priority services (land leveling, drain cleaning, gate maintenance, desalinization, monitoring support, input supply, distribution of salt-tolerant seed); apply performance-based contracts with clear service standards, measurable indicators, and independent verification; bundle services with advisory and seasonal workplans to avoid shifting salinity to neighboring plots; use de-risking tools such as aggregated demand through farmer organizations, milestone payments linked to verified outputs, and quality assurance mechanisms	Identify two to three pilot clusters per salinity system; prepare service specifications and standard contracts; pre-qualify contractors and input suppliers; agree on indicators and a verification protocol; launch pilots with a rapid learning review after the first season	Establish accredited contracts for salinity-management services (certification, training, and quality control); scale performance-based contracting with blended finance where needed; integrate private services into national subsidy and credit mechanisms for salt-tolerant seed and soil amendments; develop multi-year operation and maintenance contracting frameworks with public oversight; institutionalize digital reporting and independent verification of service delivery and infrastructure functionality

References

AfricaRice & MetaMeta. (2024). *Cartographie de la salinité des terres agricoles et horticoles au Sénégal*. Présentation PowerPoint. AfricaRice & MetaMeta. (2024, 5 août). *Tackling soil salinity in rice-based systems*. The WaterChannel.

Albergel, J., Brunet, D., Dubée, G., Montoroi, J. P., & Zante, P. (1992). Gestion d'un barrage anti-sel en basse Casamance (Sénégal). *Usage agricole de l'eau. Paris: ORSTOM*, 33-45.

Amadou, N. D. I. M., Souleymane NIANG, and Boubou Aldiouma SY. "Dégradation chimique des sols dans la Commune de Diama, Bas delta du fleuve Sénégal." *Territoires, Environnement et Développement (TED)* 1.2 (2022): 1-15.

Asch, F., Dingkuhn, M., Wittstock, C., & Doerffling, K. (1999). Sodium and potassium uptake of rice panicles as affected by salinity and season in relation to yield and yield components. *Plant and Soil, 207*(2), 133–145.

Asch, F., & Wopereis, M. C. S. (2001). Responses of field-grown irrigated rice cultivars to varying levels of floodwater salinity in a semi-arid environment. *Field Crops Research, 70*, 127–137.

Bado, B. V., Djaman, K., Mel, V., Nati, D. A. B., Baldé, A., Irmak, S., & Futakuchi, K. (2015). Agronomic performance of salt-tolerant rice genotypes in salt-affected soil under integrated management options of nitrogen, zinc and gypsum. *European Journal of Agronomy*.

Camille, C., Maina, M. E., Thompson, A., & Kramer, K. (2023). *L'impact de la salinisation des sols sur la sécurité alimentaire et les solutions politiques durables en Afrique de l'Ouest: le cas du Sénégal et de la Gambie*. Université de Chicago.

Haefele, S., Wopereis, M., Boivin, P. and N'Diaye, A. (1999). Effect of puddling on soil desalinization and rice seedling survival in the Senegal River Delta. *Soil and Tillage Research* 51(1-2): 35-46.

Ceuppens, J., Wopereis, M. C. S., & Miezan, K. M. (1997). Soil salinization processes in rice irrigation schemes in the Senegal River Delta. *Soil Science Society of America Journal, 61*(4), 1122–1130.

Dia, S. (2012). Évolution des politiques publiques dans le delta du Sénégal : Les réponses organisationnelles et spatiales au désengagement de la SAED. *VertigO*, *12*(3). https://doi.org/10.4000/vertigo.12302

Diack, M., Diop, T., & Ndiaye, R. (2014). Restoration of degraded lands affected by salinization process under climate change conditions: impacts on food security in the Senegal River Valley. In *sustainable intensification to advance food security and enhance climate resilience in Africa* (pp. 275-288). Cham: Springer International Publishing.

Diatta, M., Diédhiou, S., Goudiaby, A. O. K., Bassene, M. J., Sagna, M. Y. P., Sow, M., & Diallo, M. D. (2022). Perception et stratégies d'adaptation des producteurs face à la salinisation des vallées rizicoles de la commune d'Enampore en Basse Casamance. *European Scientific Journal*, *18*(11), 71. https://doi.org/10.19044/esj.2022.v18n11p71

Diack, M., Diop, T., & Ndiaye, R. (2015). Restoration of degraded lands affected by salinization process under climate change conditions: impacts on food security in the Senegal River

valley. In *Sustainable Intensification to Advance Food Security and Enhance Climate Resilience in Africa* (pp. 275–288). Springer.
Diallo, M. D., Ndiaye, O., Saleh, M. M., Tine, A., Diop, A., & Guisse, A. (2015). Comparative study of water and soil salinity in the northern zone of Niayes (Senegal).
Diouf, O. (2020). *Les « territoires salés » de l'eau du delta du Sénégal : Cartographie et pratiques de gestion de la salinité dans le Gorom-Lampsar* [Thèse de doctorat, Université d'Orléans]. HAL. https://theses.hal.science/tel-03629115v3
Diouf, O., Bartout, P., & Touchart, L. (2022). Indicateurs et pratiques de gestion de la salinité des sols dans le Gorom-Lampsar (delta du Sénégal). *VertigO*, *22*(3). https://doi.org/10.4000/vertigo.36362
Djaman, K., Mel, V., Boye, A., Diop, L., Manneh, B., El-Namaky, R., Koudahe, K., & Futakuchi, K. (2019). Rice genotype and fertilizer management for improving rice productivity under saline soil conditions. *Paddy and Water Environment*, 1–15.
Djibo Ka. (2013). *Question orale sur la salinisation des terres cultivables*. Direction des Relations avec les Institutions, Sénégal. https://www.dri.gouv.sn/sites/default/files/an-documents/DEPUTE_DJIBO_KA_SALINISATION.pdf
Dramé, F. A., Ndiaye, S., Djighaly, P. I., & Diarra, A. M. (2019). Analysis of the effects of climate change on pH and salinity of soil in Bakoum valley watershed (Sedhiou Region/Senegal).
Dumas, D., Mietton, M., Hamerlynck, O., Pesneaud, F., Kane, A., Coly, A., Duvail, S., & Baba, M. (2010). Large dams and uncertainties: the case of the Senegal River (West Africa). *Society & Natural Resources, 23*(11), 1108–1122.
Fall, A. C. L., Montoroi, J. P., & Stahr, K. (2014). Coastal acid sulfate soils in the Saloum River basin, Senegal. *Soil research*, *52*(7), 671-684.
FAO. (2025). *FAO Newsletter sur la gestion des terres salées au Sénégal*.
GRDR. (2008). *Contribution de la recherche au développement: La salinisation des bas-fonds en Basse Casamance*. Rapport. GRDR.
Gning, A. A., Orban, P., Garel, J., Ngom, F. D., Dassargues, A., Malou, R., & Brouyère, S. (2017). Factors controlling the evolution of groundwater dynamics and chemistry in the Senegal River Delta. *Journal of Hydrology: Regional Studies, 10*, 133–144.
Haefele, S. M., Wopereis, M. C. S., Boivin, P., & Ndiaye, M. K. (1999). Effect of puddling on soil desalinization and rice seedling survival in the Senegal River Delta. *Soil and Tillage Research, 51*, 35–46.
Hammecker, C., Antonino, A. C. D., Maeght, J. L., & Boivin, P. (2003). Experimental and numerical study of water flow in soil under irrigation in northern Senegal: Evidence of air entrapment. *European Journal of Soil Science, 54*(3), 491–503.
Ibrahim, A., Kaboré, J. E. P., Kalimuthu, S., Manneh, B., Faye, O. N., Cissé, M., & Saito, K. (2025). Combined effects of salt-tolerant varieties and improved nutrient management practices on rice yield and profitability under salt-affected soils in the West African Sahel. *Field Crops Research*, *322*, 109750.
Institut National de Pe´dologie (2008) Estimation des terres affecte´es par le processus de salinisation au Se´ne ´gal. Rapport annuel. p 38
INRA. (2019). *Agriculture et salinisation des sols: stratégies d'adaptation et solutions agricoles*.
IRD. (1991). *Synthèse des travaux IRD sur la salinisation en zone sahélienne*. Rapport IRD.

Kouton, S. E. (2024). *Impact de la salinité sur la production agricole dans le delta du Sénégal*. Mémoire de Master, UCAD.

Montoroi, J. P. (1995, April). La riziculture inondée en Basse-Casamance (Sénégal). In *Contribution des petits barrages antisel à la réhabilitation des bas-fonds chimiquement dégradés par la sécheresse In Cheneau-Loquay A., Leplaideur A.(édit.). Les ricicultures de l'Afrique de l'Ouest. Actes du colloque international Quel avenir pour les ricicultures de l'Afrique de l'Ouest* (pp. 5-7).

Ministère de l'Hydraulique et de l'Assainissement (Sénégal). (s. d.). *Programme de Gestion intégrée des Ressources en Eau*. https://mha.gouv.sn/programme-de-gestion-integree-des-ressources-en-eau/

Mel, V. C., Bado, B. V., Ndiaye, S., Djaman, K., Nati, D. A. B., Manneh, B., & Futakuchi, K. (2019). Suitable management options to improve the productivity of rice cultivars under salinity stress. *Archives of Agronomy and Soil Science, 65*(8), 1093–1106.

Montoroi, J.-P. (1994). *Étude du fonctionnement hydrologique et hydrochimique d'un bassin versant de la mangrove de Basse Casamance: apport à la connaissance du rôle d'aménagement des ouvrages anti-sel sur le cycle du sel*. Thèse de Doctorat, Université Montpellier II / ORSTOM.

Raes, D., Deckers, J., & Diallo, A. M. (1995). Water requirements for salt control in rice schemes in the Senegal river delta and valley. *Irrigation and drainage systems*, *9*(2), 129-141.

Salem, M. C. C., Descroix, L., Diakhate, M. M., Habert, E., Sy, B. A., Touré, L., & Billault, L. (2022). Le delta du fleuve Sénégal: un atlas collaboratif.

Sané, A., Sambou, H., and Sambou, A. (2025). Impacts socio-économiques et environnementaux des aménagements hydroagricoles (digues anti-sels et de retenue) dans les régions de Sédhiou et de Ziguinchor (Sénégal). *Revue Ecosystèmes et Paysages* 5.1

Sene, A. (1999). La gestion de la salinité des terres sous la canne à sucre irriguée à Richard-Toll au Sénégal.

Sadio, S., & van Mensvoort, M. E. F. (1993). Saline acid sulfate soils in Senegal. *Selected Papers of the Ho Chi Minh City Symposium on Acid Sulphate Soils*, 89–95.

Sow, S., Nkonya, E., Meyer, S., & Kato, E. (2016). Cost, Drivers and Action Against Land Degradation in Senegal. In *Economics of Land Degradation and Improvement–A Global Assessment for Sustainable Development* (pp. 577-608). Springer, Cham.

The New Humanitarian. (2017). *L'invasion du sel au Sénégal: une menace croissante pour la sécurité alimentaire*.

Thiam, S., Villamor, G. B., Kyei-Baffour, N., & Matty, F. (2019). Soil salinity assessment and coping strategies in the coastal agricultural landscape in Djilor district, Senegal. *Land Use Policy, 88*, 104191.

Thiam, S., Villamor, G. B., Faye, L. C., Sène, J. H. B., Diwediga, B., & Kyei-Baffour, N. (2021). Monitoring land use and soil salinity changes in coastal landscape: a case study from Senegal. *Environmental Monitoring and Assessment, 193*(5).

UNESCO. (2024). *Projet de résilience des écosystèmes: lutte contre la salinisation des terres au Sénégal*.

Voré Gana Seck, Ibrahima Fall, Coumba Diouf Seck Pape Ndiaye. (2015). Restauration et Valorisation des Sols Salés de Ndoff pour la Relance de la Riziculture au Sénégal.

https://satoyamainitiative.org/old/wp-content/uploads/2015/03/Case-study-from-Green-Senegal-in-French.pdf

Winterbottom, R., McGahuey, M., & Tappan, G. (2020). Adoption of farmer managed natural regeneration in Senegal. *ETFRN (European Tropical Forest Research Network) newsletter*, *60*, 69-76.

Wopereis, M., Ceuppens, J., Boivin, P., Ndiaye, A. and Kane, A. (1998). Preserving soil quality under irrigation in the Senegal River Valley. *NJAS wageningen journal of life sciences* 46(1): 97-107.

World Bank. (2022). *Challenges and Recommendations for Enhancing Availability of Water Resources in Senegal*. Global Water Practice, February 2022.

Annex

Annex 1. Minutes of the workshop on the presentation of the results of the Scoping Study on Salinity

Date & Time: 28 January 2026 (13:00–14:45, Senegal time)

Venue: Online (Zoom)

Organizer: Netherlands Food Partnership (NFP)

Participants: Dr. Ali Ibrahim (Presenter, Africa Rice Center), approximately 20 participants

Agenda:

1. Presentation of the results of the salinity situation survey
2. Question-and-answer session, and other related discussions

1. Opening Remarks:

Opening remarks were delivered by Mr. Martin van Staffren, who introduced the Netherlands Water Partnership (NWP) and the Netherlands Food Partnership (NFP) as sector-based platforms in the Netherlands for the water and food sectors, respectively, responsible for coordination among relevant stakeholders and the promotion of partnerships.

It was explained that, in recent years, a cross-sectoral framework focusing on salinity (salt accumulation) has been established, under which activities have been implemented in multiple countries. Vietnam, Bangladesh, Egypt, and Senegal have been identified as priority countries, and salinity situation surveys have been conducted in collaboration with local partners. The surveys aim to contribute to the formulation of a medium- to long-term roadmap for salinity management programs that integrate research and implementation.

Furthermore, it was stated that the purpose of the workshop was to systematically the salinity issues in Senegal, share the survey methodologies, key findings, and existing response measures, and exchange views toward the development of future action plans.

2. Presentation of the Salinity Situation Survey Results (Dr. Ali, Africa Rice Center)

Dr. Ali of the Africa Rice Center delivered a presentation in PowerPoint format. A summary of the presentation is provided below.

A) Background and Objectives

Salinity is one of the major land degradation issues in Senegal, having serious impacts on agricultural productivity, water resources, and rural livelihoods. Since 2012, the area affected by salinity has shown an increasing trend, posing growing risks particularly to high-value agricultural systems such as irrigated rice cultivation.

The objective of this survey was to identify the locations, causes, and types of salinity, analyze its impact on production systems and livelihoods, review existing countermeasures, and identify priority areas for targeted investment.

B) Survey Methodology

The survey was conducted using two main approaches: (1) a literature review and (2) stakeholder consultations.

Under approach (1), a mixed-methods framework was applied to capture environmental, institutional, and socio-economic aspects. Relevant domestic and international reports, literature on salinity, water resources, and climate change, past and ongoing related programs, as well as postgraduate research outputs were reviewed.

Under approach (2), semi-structured interviews were conducted with stakeholders in the water, agriculture, environment, research, and extension sectors, as well as with organizations and communities in salinity-affected areas, in order to identify the causes of salinity, existing response measures, and challenges related to the scaling up of such measures.

C) Review of Survey Findings

(1) Overall Salinity Situation and Priority Area:

- The survey results confirmed that salinity is present across multiple areas, including coastal aquifers, horticultural farmland in the Niayes region, river deltas, and low-lying wetlands, indicating that salinity constitutes a widespread and structural issue rather than a localized problem.
- Salinity was found to occur and expand as a result of the combined effects of natural conditions—such as climate, hydrology, and topography—and anthropogenic factors, including irrigation and drainage management. Based on the survey findings, the following three areas were identified as priority regions with high salinity risk and significant potential for effective intervention:

(i) Irrigated rice-growing areas in the Senegal River Delta;

(ii) Lower Casamance rice valleys (Ziguinchor-Sedhiou);

(iii) Sine-Saloum coastal lowlands (Fatick and Kaolack).

- In these regions, diverse salinity drivers were observed, including rising salinity in shallow groundwater, seawater intrusion, inadequate drainage, deterioration of irrigation water quality, and the combined effects of salinity and soil acidity, with variations depending on local conditions.

(2) Major Drivers of Salinity:

- In the Senegal River Basin, high evapotranspiration rates combined with insufficient rainfall have led to capillary rise in areas with shallow groundwater tables, resulting in the accumulation of salts in surface soil layers.
- In coastal areas, seawater intrusion has progressed due to sea-level rise and reduced river discharge, increasing salinity levels in soils and groundwater and thereby exacerbating salinity problems.
- From an agricultural management perspective, the use of saline irrigation water, dysfunction of collective drainage systems, and excessive irrigation practices have contributed to the aggravation of salinity.
- In addition, insufficient technical support and limited operation and maintenance capacities among farmers and technicians have constrained long-term water management and salinity balance control.

(3) Impacts on Production, Water Environment, and Livelihoods:

- In rice-growing areas of the Senegal River Delta, cases were identified in which yield losses exceeding 1 ton/ha occurred under salinity conditions. For salt-sensitive varieties, yield reductions ranged from 40 to 80 percent and, in some cases, reached nearly 90 percent.
- Interviews with farmers indicated that yield decline is perceived as the most severe and urgent impact. Continued yield losses have exacerbated poverty through farmland abandonment and reduced household income.
- In the Senegal River Delta, water quality deterioration—such as contamination by agrochemicals, heavy metals, and bacteria, as well as eutrophication—has been observed, partly due to pesticide use associated with vegetable production, raising concerns about declining water use functions.
- Waterlogging caused by inadequate drainage was found to pose potential health risks to local populations, in addition to causing agricultural damage.
- In coastal rice-growing areas, particularly in Casamance, the deterioration of land conditions was observed to have a disproportionately greater impact on the production activities of women farmers, indicating gender-related vulnerabilities.

(4) Existing Measures and Field-Level Practices

- In Senegal, more than 30 salinity-related projects have been implemented by the government and development partners, focusing on salinity control, land improvement, and capacity development.
- Farmers have addressed salinity by combining water management measures—such as drainage improvement and salt leaching—with agronomic practices, including the adoption of salt-tolerant varieties, crop rotation, and the application of compost and crop residues.
- While anti-salinity dikes and small-scale dams have demonstrated a certain level of effectiveness, their sustainability remains a challenge due to inadequate operation and maintenance.
- Effective measures have not been sufficiently scaled up due to constraints such as limited accessibility to and high costs of soil amendments and salt-tolerant varieties, dysfunction of drainage facilities, and insufficient knowledge and technical capacity.
- Although farmers recognize salinity empirically through changes in soil and crop conditions, there is a lack of quantitative criteria (thresholds) to support informed farm management decisions.

(5) Conclusions and Key Recommendations of the Survey

- Salinity management should be implemented not as the introduction of individual technologies, but as a system-wide intervention centered on the restoration of drainage capacity.
- Priority regions, including the Senegal River Delta and coastal and Niayes areas, should be targeted with context-specific measures deployed in a phased and prioritized manner.
- To better understand the spatial distribution and severity of salinity, a minimum set of salinity monitoring indicators should be established, and salinity maps should be regularly updated.
- With regard to indicators, target areas, and data-sharing mechanisms, it is important to promote consensus-building among relevant stakeholders, led by the national soil research institution in collaboration with research institutes, universities, and AfricaRice.
- For critical infrastructure such as drainage channels, sustainable operation and maintenance systems should be established to ensure functionality beyond the project period.
- For farmers, integrated technical and farm management packages combining drainage improvement, salt-tolerant varieties, and soil amendment practices should be developed and disseminated through demonstration plots and extension activities.
- To improve access to salt-tolerant seeds and related inputs, strengthened collaboration with the private sector and scale-up through piloting in selected areas are recommended.

(6) Recommendations on Implementation Arrangements and Coordination

- Insufficient coordination among existing programs addressing salinity management has been identified. To enhance the effectiveness and efficiency of interventions, strengthened coordination and linkages among relevant programs are essential.
- It is recommended to establish a coordination and management committee (steering committee) comprising the Ministry of Agriculture, the Ministry of Environment, extension services, research

institutes, universities, and other relevant stakeholders, in order to facilitate the sharing of project progress, outcomes, and data.

- Through this committee, systematic accumulation and utilization of knowledge and data to inform policy formulation and decision-making on salinity management should be promoted.

3. Question and Answer Session:

Q To what extent is salinity positioned within policies and strategic plans of the Government of Senegal, and are there any clear policies or strategies specifically addressing salinity?

→ The Government of Senegal, primarily through the Ministry of Agriculture and the Ministry of Environment, has formulated strategic plans that include salinity management measures. These include farmer support through the construction of anti-salinity dams and the provision of seeds for salt-tolerant crop varieties, particularly rice.

→ It was also noted that, while more than 30 salinity-related projects have been implemented to date in collaboration with the government, these initiatives have tended to be implemented on a project-by-project basis. As a result, the integration of outcomes and the development of a long-term, strategic approach have been limited. In this context, the survey recommends the formulation of a long-term and integrated salinity management strategy that goes beyond individual project interventions.

Q Is there a national- or regional-level monitoring framework or observation network in place to track the progression of salinity and groundwater quality (including seawater intrusion), beyond individual project-based initiatives?

→ At present, there is no systematic or nationwide monitoring system in Senegal specifically targeting salinity or groundwater quality. While some project- or area-based surveys have been conducted, available data remain limited and do not support continuous or large-scale monitoring.

→ It was also noted that, due to the absence of clear salinity indicators and accessible data, farmers often become aware of salinity problems only at a visually observable stage, such as the appearance of salt crusts on the soil surface. This further confirmed that the establishment of a salinity monitoring framework and the development of relevant data systems constitute an urgent challenge.

In salinity management, groundwater monitoring that includes groundwater levels, in addition to salinity concentration, is essential. The impacts of sea-level rise may manifest not only through direct seawater intrusion but also indirectly through changes in groundwater levels. For the appropriate design of countermeasures, the establishment of a monitoring framework and the continuous collection of data on groundwater salinity and groundwater levels are considered indispensable.

Q What role could modular and decentralized desalination technologies play in Senegal, particularly for controlled environment agriculture (such as greenhouse production) and other potential applications?

→ In Senegal, farmland abandonment attributable to salinity has been observed, particularly in the Senegal River Delta, and technologies and approaches that contribute to salinity management are generally welcomed. Desalination technologies may also warrant consideration as part of national-level salinity management efforts.

→ However, while the Government of Senegal has strategies related to salinity management, current implementation remains at a limited scale. Therefore, any consideration of the application of desalination technologies should be undertaken in close coordination with the government and relevant development partners.

Q In Senegal, particularly in the southern regions, rainfall is concentrated in specific periods of the year. Has consideration been given to mechanisms for retaining freshwater available during the rainy season and utilizing it through the dry season? In other countries, such as Egypt and Vietnam, there are examples of projects that store freshwater during the rainy season and enable its long-term use for crop production in the dry season, including approaches such as water storage using acacia and hydroponic cultivation systems. Would the application of such technologies be considered in Senegal? (Mr. Bas Brüning, The Salt Doctors Inc.)

→ In the southern regions, high evaporation rates constitute a major driver of salinity. Some farmers have attempted to reduce evaporation through agronomic management practices such as crop rotation and soil cover using crop residues. However, crop residues are often used as livestock feed, which limits their availability for soil cover; as a result, the dissemination of such practices remains limited. Consequently, many farmers tend to prioritize relatively more feasible measures, including the adoption of salt-tolerant varieties and the application of soil amendment materials.

→ In the Senegal River Delta, drainage improvement measures and the use of salt-tolerant varieties constitute the primary response options. The specific measures implemented vary depending on local conditions and the resources available to farmers.

Q The Global Green Growth Institute (GGGI) has been engaged in salinity management through initiatives such as solar-powered drainage systems covering approximately 4,000 ha and the testing and introduction of salt-tolerant rice varieties in collaboration with AfricaRice. However, awareness of promising technologies among farmers remains low, and insufficient coordination among organizations is considered to be constraining the effectiveness of these efforts. In this context, how can the promising technologies and solutions developed by AfricaRice be scaled up in the future, and in what ways could partners, including GGGI, contribute to supporting such scale-up?

→ As a next step, the formation of large-scale collaborative projects involving the private sector and development partners is considered essential. Such efforts should go beyond the dissemination of existing technologies and focus on the co-development of solutions tailored to local contexts and production systems. In addition, it is important to share the perspective that salinity is a system-wide challenge rather than a site-specific issue, and to strengthen collaboration among diverse stakeholders.