COUNTRY BRIEF

GLOBAL CENTER ON ADAPTATION

The Gambia

Adaptation & Resilience Options for the Water Sector

Lead Authors: **GCA Infrastructure & Nature-based Solutions:** Martin Garcia Perez; Merita Salihu; Anne-Laure Solnon; Edwina Mercer, Adele Cadario.

Contributing Authors: This brief builds on national and investment-level climate analyses conducted by GCA under the Africa Adaptation Acceleration Program (AAAP). The work benefited from collaboration with the World Bank teams for The Gambia Infrastructure Project and CCDR, as well as insights shared by the Ministry of Transport Works & Infrastructure, the Ministry of Environment and Climate Change, NAWEC, the Department of Water Resources and the National Roads Authority.

CONTENTS

EXECUTIVE SUMMARY

- **Communities depending on the Gambia River and shallow aquifers face worsening over-extraction, salinization, and climate variability as demand doubles by 2050.**
- **Though water resources remain stable, rising rainfall variability, drought, and salinity will strain agriculture and coastal areas.**
- **Agriculture, supporting 75% of livelihoods, could lose 30% of rice fields to salinity by 2050, while over-abstraction threatens GBA groundwater and wetlands.**
- **Investing 1–5% of water-asset value in impact-based adaptation —through climate-smart agriculture, groundwater regulation, monitoring systems, and green-blue infrastructure— can yield 2–4× returns through improved reliability.**
- **NBS solutions could restore 20,000 ha for recharge and carbon gains.**

The Global Center on Adaptation (GCA) is an international organization working to accelerate action on adapting to climate change and building resilient economies.

Under the African Adaptation Acceleration Program (AAAP), GCA supports The Gambia in embedding climate resilience into national planning and infrastructure investment projects –including The World Bank Gambia Infrastructure Project, The African Development Bank Banjul Port 4th Expansion and Senegambia Bridge Asset Recycling projects. Since 2024, GCA has partnered with IFIs, government institutions, and the National Roads Authority to assess climate risks to the transport sector, water resources, identify adaptation solutions, and strengthen local capacity though training activities.

1. SECTORIAL VULNERABILITIES

The Gambia's water resources underpin domestic supply, agriculture, and industry, yet face mounting pressures from population growth, lack of infrastructure and climate change. Domestic water demand is projected to triple by 2050, driven by an annual population growth of 2.3%[1]. Industrial demand could increase tenfold alongside manufacturing expansion and agricultural demand nearly double over the same period, reflecting a 60% rise in agricultural production projected by mid-century[2].

Persistent infrastructure gaps remain a core vulnerability, constraining both water availability and quality. Although 86% of Gambians have access to basic drinking water, only 48% benefit from safely managed sources[3], revealing service and quality deficits. Urban–rural disparities are stark: near-universal coverage in the Greater Banjul Area contrasts with rural and riverine communities that still rely on unprotected wells and untreated groundwater. Insufficient treatment capacity further exacerbates water quality challenges.

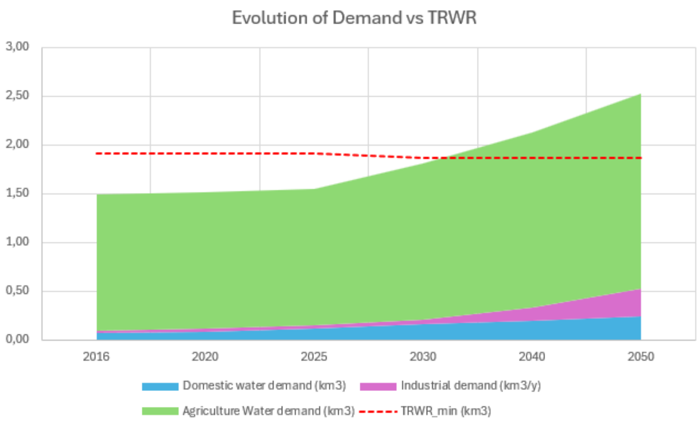

Figure 1. Projected water demand vs projected Total Renewable Water Ressources. Note: Only the 5% percentile lower bound of the TRWR is plotted. Average TRWR is projected to go from 5,1 km3 today to 5 km3 in 2050. Environmental flows are not included.

As a result, many communities rely on the Gambia River, rainfed surface waters, and shallow aquifers, where over-extraction, salinization, and rainfall variability are already serious challenges[4] that are projected to intensify by 2050. Current sustainable water availability fluctuates sharply—from −0.5 to +1.0 km^3/year—indicating that abstraction often exceeds recharge. The country's Total Renewable Water Resources average 5.1 km^3/year (1995–2024), ranging from 0.6 to 11 km^3, and rely heavily on transboundary inflows from Senegal and Guinea, with nearly half of all years showing negative recharge[5].

2. CLIMATE CHANGE IMPACTS ON THE WATER SECTOR

Climate change is expected to intensify pressure on The Gambia's water resources through more erratic rainfall, prolonged dry spells, higher temperatures, and rising sea levels, notably:

- **Dry spells and heat extremes are lengthening**, with consecutive dry days increasing from 135 to 160 per year by 2025 and days above 40°C projected to rise from 60 to 100 by 2050 (SSP2) in the east. Drought exposure is also projected to intensify, particularly in the east, with extreme drought conditions (SPEI<−2) likely under SSP5 by 2100[5].
- **Rainfall variability will increase** by mid-century even if annual totals remain stable. Short, high-intensity rainfall events are projected to grow by up to 20%, particularly for 1-day rainfall in the Upper and Central River Regions by 2050 (SSP2). Simultaneously, growing intra-annual rainfall variability and rising evapotranspiration by 7–15% could reduce effective water availability and aquifer recharge[5].
- **Sea-level rise will exacerbate saltwater intrusion**, particularly in low-lying areas and the GBA. The Gambia River estuary already sees saline penetration up to 180 km inland in the wet season and 250 km in the dry season. With sea levels projected to rise by 0.2–1.2 m by 2100, the salt front is expected to advance further upstream, salinizing freshwater ground and surface sources used for drinking and irrigation[6].

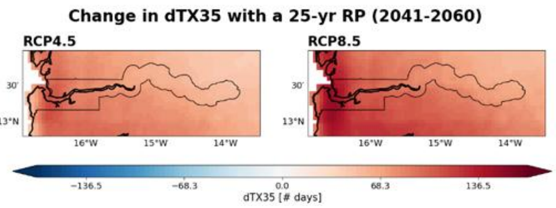

Figure 2. Change in the projected number of days exceeding 35°C with a 25-year return period, for both the SSP2 and SSP5 scenarios.

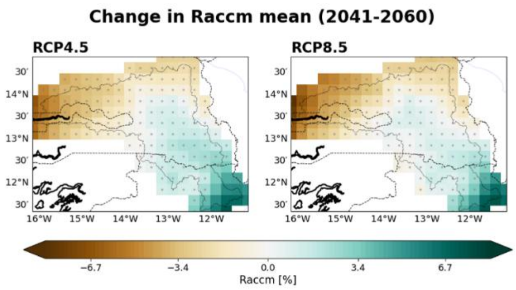

Figure 3. Change in mean accumulated precipitation per year for the GRB.

While The Gambia's overall water resources are expected to remain broadly sufficient to meet future demand by 2050, greater year-to-year variability and localized imbalances are anticipated. Sustainable availability averages 0.19 km³/year, currently exceeding domestic (0.09 km³) and industrial (0.035 km³) use, yet industrial demand could reach 0.28 km³ by 2050, potentially surpassing sustainable limits and intensifying competition with agriculture and ecosystems. Although projected household demand (0.18 km³) is likely to remain manageable, rising variability, groundwater depletion, and declining quality—driven by drought and salinization—pose mounting risks, particularly for agricultural areas, riverine communities, the Greater Banjul Area, and flow-regulating wetlands[6].

Year	Expected population	Expected annual growth rate (%)	NRW	Domestic water demand (km3)	Agriculture Water demand (km3)	Industrial demand (km3/y)	TRWR_min (km3)	TRWR (average)	TRWR (max)
2016	1.900.000	2,8	0,4	0,07	1,4	0,02	1,92	5,07	8,37
2020	2.161.356	2,6	0,4	0,09	1,4	0,03	1,92	5,07	8,37
2025	2.422.712	2,5	0,4	0,11	1,4	0,03	1,92	5,07	8,37
2030	3.263.651	2,2	0,3	0,14	1,6	0,05	1,86	5,00	8,29
2040	3.984.778	1,8	0,2	0,15	1,8	0,13	1,86	5,00	8,29
2050	4.673.743	1,4	0,2	0,18	2,0	0,28	1,86	5,00	8,29

Figure 4. Current and projected evolution of water demand and TRWR. Source: Water Sector Climate Risk Assessment, GCA, 2025

Agriculture, which supports around 75% of household incomes and underpins key export value chains, remains largely rainfed, leaving production and rural livelihoods highly exposed to climate variability and salinity intrusion. Most cultivated land dependent on rainfall, will be impacted by longer dry spells and erratic precipitation threaten yields, particularly in the Upper and Central River Regions. Regional projections indicate 10–20% yield declines across West Africa by the end of the century[7], while in The Gambia, droughts in 2011 and 2014 reduced national crop output by about 50%[8]., a trend expected to continue without adaptation. Along the Gambia River, where irrigation depends on surface water, saltwater intrusion could render 30% of rice fields unusable within the next decade[9], while a 1 m sea-level rise may inundate 20% of rice croplands[10], undermining food security and export potential. As surface water becomes saline, farmers are expected to rely more heavily on groundwater abstraction, exacerbating aquifer depletion and recharge decline. Rising temperatures and recurrent droughts will further strain livestock systems, with rangeland productivity in West Africa projected to drop by 42% by 2050 (SSP2)[1]. Together, these pressures will erode agricultural productivity, reduce rural incomes, and intensify competition for scarce freshwater resources across sectors[11].

In the Greater Banjul Area (GBA), where groundwater supplies most domestic and industrial demand, rising over-extraction and sea-level rise are compounding access challenges and accelerating salinity intrusion, degrading water quality. Although precipitation trends in the region show moderate decline by 2050, sea-level rise and anthropogenic pressures—including unregulated abstraction and rapid urban growth—remain the dominant drivers of reduced availability and contamination risk[12].

Wetlands across The Gambia, including the Tanbi Wetland Complex and the inland floodplains of the Lower and Central River Regions, provide vital ecosystem services for water resources and underpin the livelihoods of nearby communities. However, rising temperatures, greater rainfall variability, salinity, and expanding land-use pressures are expected to drive wetland shrinkage and degradation, diminishing their capacity to buffer floods, supply freshwater, sequester carbon, and regulate salinity. These changes are already disproportionately affecting wetland-dependent populations, with some communities reporting income declines of up to 60%[13] due to reduced resource availability.

3. PRIORITY INVESTMENTS FOR IMPACT-BASED ADAPTATION

Targeted adaptation measures in The Gambia's water sector can substantially reduce climate risks by mid-century—safeguarding drinking water security, food production, and ecosystems—while offering high returns: estimates indicate that periodic investment on the order of one to five percent of water-related asset value can yield benefit-cost ratios between two and four, as avoided damages, reduced downtime, and stabilized services compound over asset lifetimes[14].

Priority and scalable measures, where The Gambia has consolidated experience, include:

- **Climate-Smart Agriculture (CSA) systems** —including minimum tillage, balanced fertilization, drought- and salt-tolerant crop varieties, and efficient irrigation— could more than double yields across vital crops for food security and increase rice production up to sevenfold by 2050 under climate change conditions[15]. Expanding tidal, pump, and drip irrigation systems, along with small-scale water harvesting structures—such as ponds, retention ridges, bunds, and recharge pits—while still having relatively low adoption rates nationwide[16], are expected to improve soil moisture retention and buffer against increasingly irregular rainfall patterns[16]. Expanding salt-resilient rice varieties, contour bunding, and on-farm water management could also substantially increase resilience in tidal lowlands and groundnut-growing areas. While relevant institutional frameworks are in place, limited access to agricultural risk insurance and weak incentives for producers to adopt CSA technologies remain key barriers to implementation and long-term resilience building[10]. The Gambia is already implementing these technologies via FAO support or projects like the World Bank GIRAV[17].

- **Decision Support Systems (DSS)** for integrated water management can help The Gambia anticipate and manage shortages by combining real-time data on surface and groundwater availability, demand, and quality. Expanding monitoring infrastructure—particularly for salinity—is a critical first step, enabling integration of weather forecasts and early-warning systems, especially in the Greater Banjul Area. A water-use hierarchy within the DSS could further guide equitable allocation during droughts or saltwater intrusion, protecting essential users and services.
- **Demand Management, wellfield protection and enhanced efficiency:** strengthening borehole regulation—currently a key institutional gap—is critical to ensure sustainable groundwater use. This includes licensing and metering abstractions, enforcing sanitary set-backs around intakes and dumpsites, and reducing non-revenue abstraction and contamination risks. In parallel, scaling ongoing efforts to reduce NRW —through leak detection, maintenance, and smart metering— and water efficiency measures to curb demand will also positively impact water resources. The Gambia is currently investing in some of these measures, including the Water Supply Project in the Greater Banjul Area (WASIB), co-financed by the EIB.
- **Floodplain conservation and water harvesting**: Upstream catchment rehabilitation and floodplain reconnection can restore natural floodplain storage, helping to moderate flood peaks, reduce sedimentation in intakes and canals, and sustain dry-season baseflows that support water supply and ecosystems. In urban areas, green-blue infrastructure such as bioswales, permeable pavements, and constructed wetlands can reduce pluvial flood damage and enhance groundwater recharge in rapidly growing zones–particularly along the Kotu stream in GBA— and in line with the NAP and Ramsar priorities. The WACA program in The Gambia hosts good examples of this approach.

Other potential high-impact measures include:

- **Water Availability**
  - **Transboundary Water Management**: Implement IWRM through OMVG to coordinate water use among sectors and countries, optimizing regional water management and supporting initiatives like the Sambangalou Dam.
  - **Move Water-Intensive Activities Upstream**: Encourage industries and irrigation schemes to locate in upstream areas with reliable freshwater and lower salinity, supported by spatial planning, SEZs, or upstream water supply transfers
  - **Managed Aquifer Recharge (MAR):** use recharge wells, water spreading, and streambed modifications to enhance groundwater recharge, especially in coastal and urban areas vulnerable to salinization.
  - **Sustainable Deep Aquifer Exploitation**: Conduct hydrogeological mapping and surveys to assess deep aquifers for sustainable use, supported by incentives for private drilling companies to invest in deeper drilling equipment.
- **Water Quality**
  - **Pollution Control**: Strengthen regulation and enforcement to reduce pollution from agriculture, industry, and sewage; ensure safe siting of boreholes away from dumpsites and improve inter-ministerial coordination.

 - **Wastewater Treatment & TSE Reuse**: Upgrade urban wastewater treatment plants to protect public health and enable treated effluent reuse for irrigation and non-potable uses, reducing pressure on freshwater sources.
- **Infrastructure Development**
  - **Investments in climate-resilient pipelines, treatment plants, and conveyance systems** to reduce leakage, withstand extreme events, and ensure reliable service delivery. Reinforcing preventive maintenance capacity and embedding climate-resilient practices to extend asset lifespans and reduce operational costs.
  - **Integrated Water Resources Management** (IWRM) to unlock cross-sector benefits, strengthen basin-level coordination, and enable groundwater licensing and enforcement for more sustainable use.

In parallel, regulatory and infrastructure reforms are essential to secure long-term resilience. A National Water Act could establish clear abstraction limits, regulate borehole drilling, and embed sustainable groundwater management principles. Investments in climate-resilient infrastructure—including robust pipelines, treatment plants, and conveyance systems—will reduce leakage, withstand extreme events, and ensure reliable service delivery.

Together, these measures would not only secure water availability and quality but also generate high co-benefits across agriculture, health, and ecosystems, with scalable solutions such as rainwater harvesting, and wetland restoration delivering immediate gains and long-term resilience.

4. NATURE-BASED SOLUTIONS AS AN OPPORTUNITY TO ENHANCE WATER AVAILABILITY

Nature-based solutions (NbS) can play a vital role in enhancing water capture, recharge, and supply resilience alongside conventional infrastructure. The Gambia's extensive wetland network—including the Tanbi Wetland Complex, Bao Bolon Wetland Reserve, and Niumi National Park, all designated Ramsar sites—stores large volumes of freshwater, regulates hydrological flows, and supports biodiversity and livelihoods. Mangrove restoration can buffer storm surges, slow saline intrusion, and protect groundwater supplies, while catchment rehabilitation and floodplain reconnection upstream can moderate flood peaks, reduce sedimentation, and sustain dry-season baseflows.

Preliminary analyses identify around 20,000ha of bare and grassland nationwide, with particular priority to 600ha of current bare land, that could be revegetated for water retention and aquifer recharge, offering cost-effective adaptation to increased future rain variability. Most suitable areas would represent an increase of around to 2 to 20% of current wetland areas, up to 2 to 30% of increased carbon sequestration, and associated co-benefits for communities. An additional 17,000ha of currently cropland are identified as being potentially suitable for including water conservation practices, while preservation of the current vast mangroves, wetlands and forests is the first line of defence for water conservation[18].

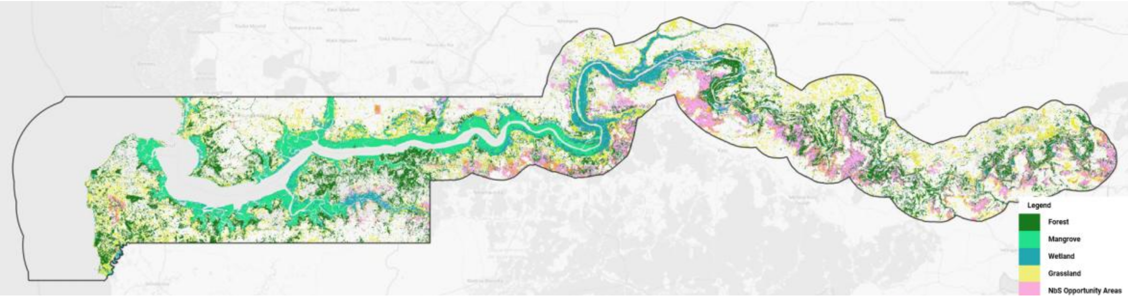

Figure 5. Existing ecosystems and NbS Opportunity Areas; Source: GCA-Oxford University Global Tools for NBS

To ensure the effectiveness and long-term performance of nature-based interventions, it is essential to establish monitoring indicators that track both hydrological and ecological outcomes. Water quality should be assessed through physico-chemical parameters such as salinity, organic content (COD, BOD), and nutrient levels (TN, TP, NH_4), while biodiversity indicators—including species richness and diversity indices—can help evaluate ecosystem recovery and resilience. Embedding these metrics within project monitoring frameworks will support adaptive management and demonstrate the co-benefits of NbS for water security and ecosystem health.

REFERENCES

1. United Nations. (2024). UN Data Portal. https://data.un.org/
2. Aikin, J. (2024). *International Monetary Fund Country Report: The Gambia*. IMF
3. Global Water Security and Sanitation Partnership: Annual Report 2022 (World Bank)
4. AGRER-GOPA-PESCARES. (2024, March 26). Impact assessment of the saltwater intrusion on rice field production (Final version). National Environment Agency. https://nea.gm/wp-content/uploads/2024/07/5-Saltwater-Intrusion-Impact-Assessment-.pdf
5. Global Center on Adaptation, Climate Hazard Assessment Report on The Gambia, 2025; and the World Bank Climate Change Knowledge Portal
6. Global Center on Adaptation, Climate Risk Assessment Water Resources of The Gambia, 2025
7. Abebaw, S. E. (2025). A global review of the impacts of climate change and variability on agricultural productivity and farmers' adaptation strategies. *Food Science & Nutrition, 13*(5), e70260. https://doi.org/10.1002/fsn3.70260
8. International Fund for Agricultural Development (IFAD). (2019). *The Gambia Country Strategic Opportunities Programme*. IFAD.
9. National Environment Agency (NEA). (2024). *Saltwater Intrusion Impact Assessment for The Gambia*. nea.gm/wp-content/uploads/2024/07/5-Saltwater-Intrusion-Impact-Assessment-.pdf
10. United Nations Framework Convention on Climate Change (UNFCCC). (2023). Case Study: Building Food-Resilient Systems in The Gambia. https://unfccc.int/sites/default/files/resource/The_Gambia_Case_Study.pdf
11. Intergovernmental Panel on Climate Change (IPCC). (2022). *Sixth Assessment Report, Working Group II: Impacts, Adaptation, and Vulnerability*. www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Chapter09.pdf
12. Ferguson, G., & Gleeson, T. (2012). Vulnerability of coastal aquifers to groundwater use and climate change. *Nature Climate Change, 2*(5), 342–345. https://doi.org/10.1038/nclimate1413
13. Ceesay, A., Wolff, M., Njie, E., Kah, M., & Koné, T. (2016). Adapting to the inevitable: The case of Tanbi Wetland National Park, The Gambia. In W. Leal Filho, H. Musa, G. Cavan, P. O'Hare, & J. Seixas (Eds.), *Climate change adaptation, resilience and hazards* (pp. 257–274). Springer International Publishing. https://doi.org/10.1007/978-3-319-39880-8_16
14. Hallegatte, S., Rozenberg, J., Rentschler, J., Nicolas, C., & Fox, C. (2019). *Strengthening new infrastructure assets: A cost-benefit analysis* (Policy Research Working Paper No. 8896). World Bank. https://documents1.worldbank.org/curated/en/962751560793977276/pdf/Strengthening-New-Infrastructure-Assets-A-Cost-Benefit-Analysis.pdf
15. International Institute for Applied Systems Analysis (IIASA). (2023). *Securing Sustainable and* Resilient *Food Systems for The Gambia* (Policy Brief No. 36). https://iiasa.ac.at/sites/default/files/2023-04/PB36_Gambia-WEB.pdf
16. Food and Agriculture Organization (FAO). (n.d.). FAO. openknowledge.fao.org/server/api/core/bitstreams/8e02d0c5-ad86-4234-8cee-ece99b0b665c/content
17. World Bank. (2024, June 20). *Transforming The Gambia's agriculture: From subsistence to market-oriented farming*. www.worldbank.org/en/news/feature/2024/06/14/transforming-the-gambia-s-agriculture-from-subsistence-to-market-oriented-farming?utm_source=chatgpt.com
18. Global Center on Adaptation (GCA) & Oxford University. (2024). *Nature-Based Solutions Opportunities Database*. Global Center on Adaptation.