



SUDAN CONFLICT CONFERENCE

April 14–15, 2026 | Cairo, Egypt



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POLICY
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FOOD FRONTIERS
AND SECURITY

Data-Driven and Spatially Informed Resilience Pathways for Conflict-Affected Sudan

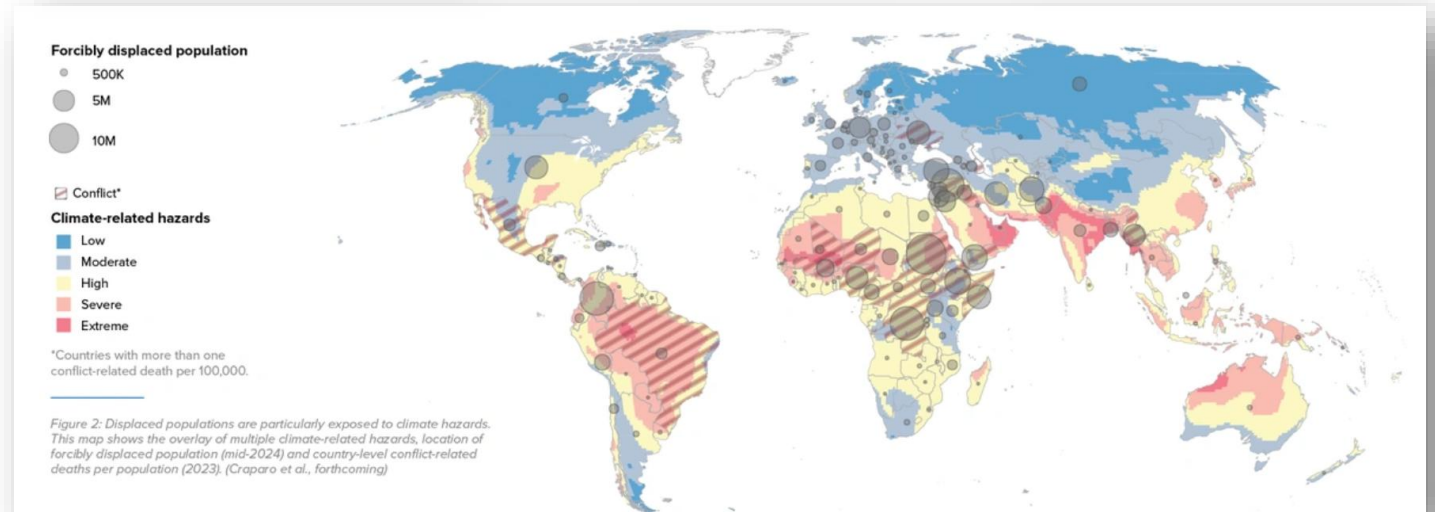
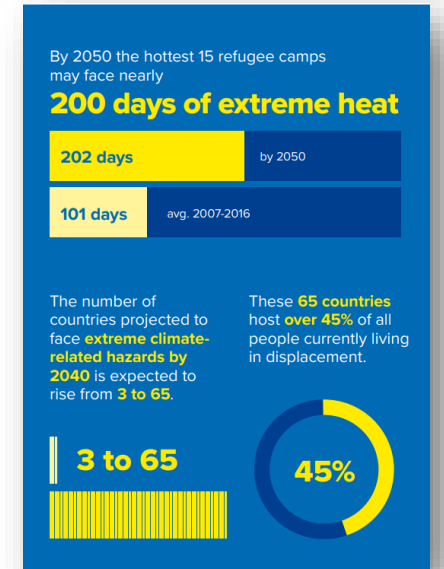
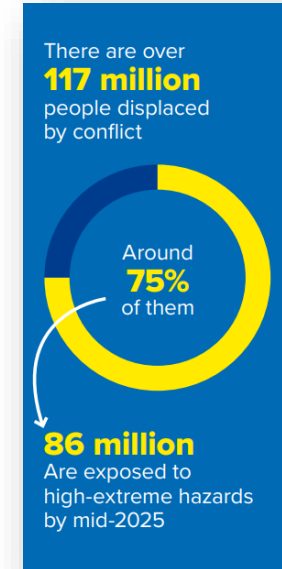
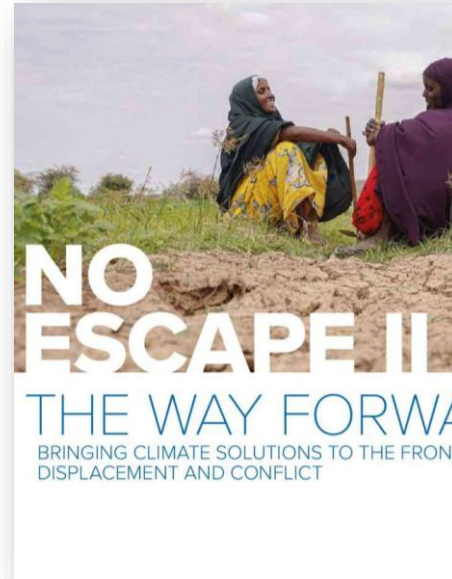
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Background

Global Context

- Displacement rising globally, concentrated in fragile contexts
- Climate change acts as a risk multiplier
- Climate + conflict drive compounded vulnerability
- Most displacement occurs in climate hotspots
- Humanitarian response remains reactive

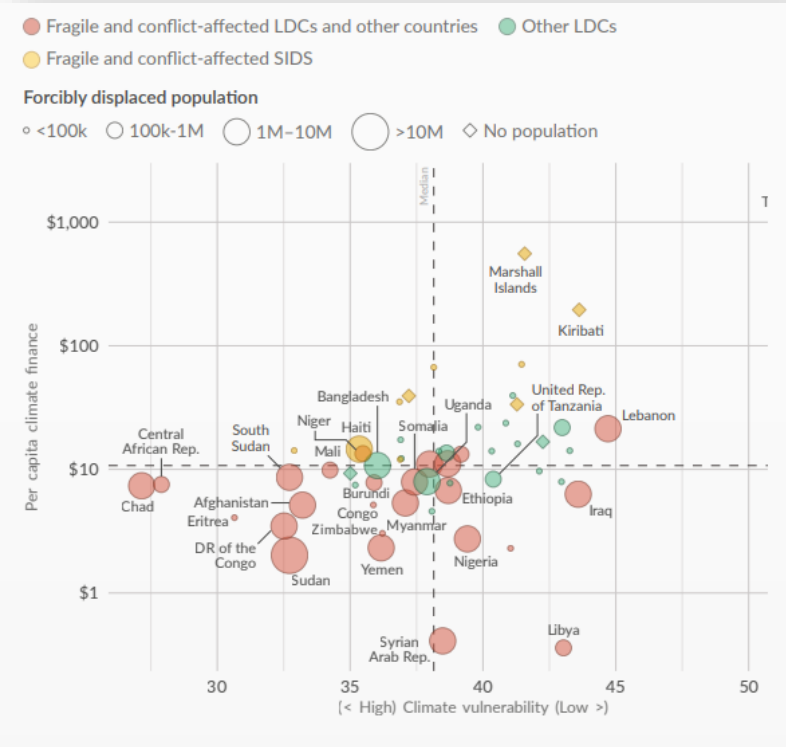


Background

Sudan

- Sudan reflects this global convergence
- Largest global humanitarian crisis
- Millions of refugees and IDPs
- Massive, unplanned displacement and resettlement
- Severe pressure on water, land, and services
- Displacement degradation nexus
- Climate risk
- Finance gap

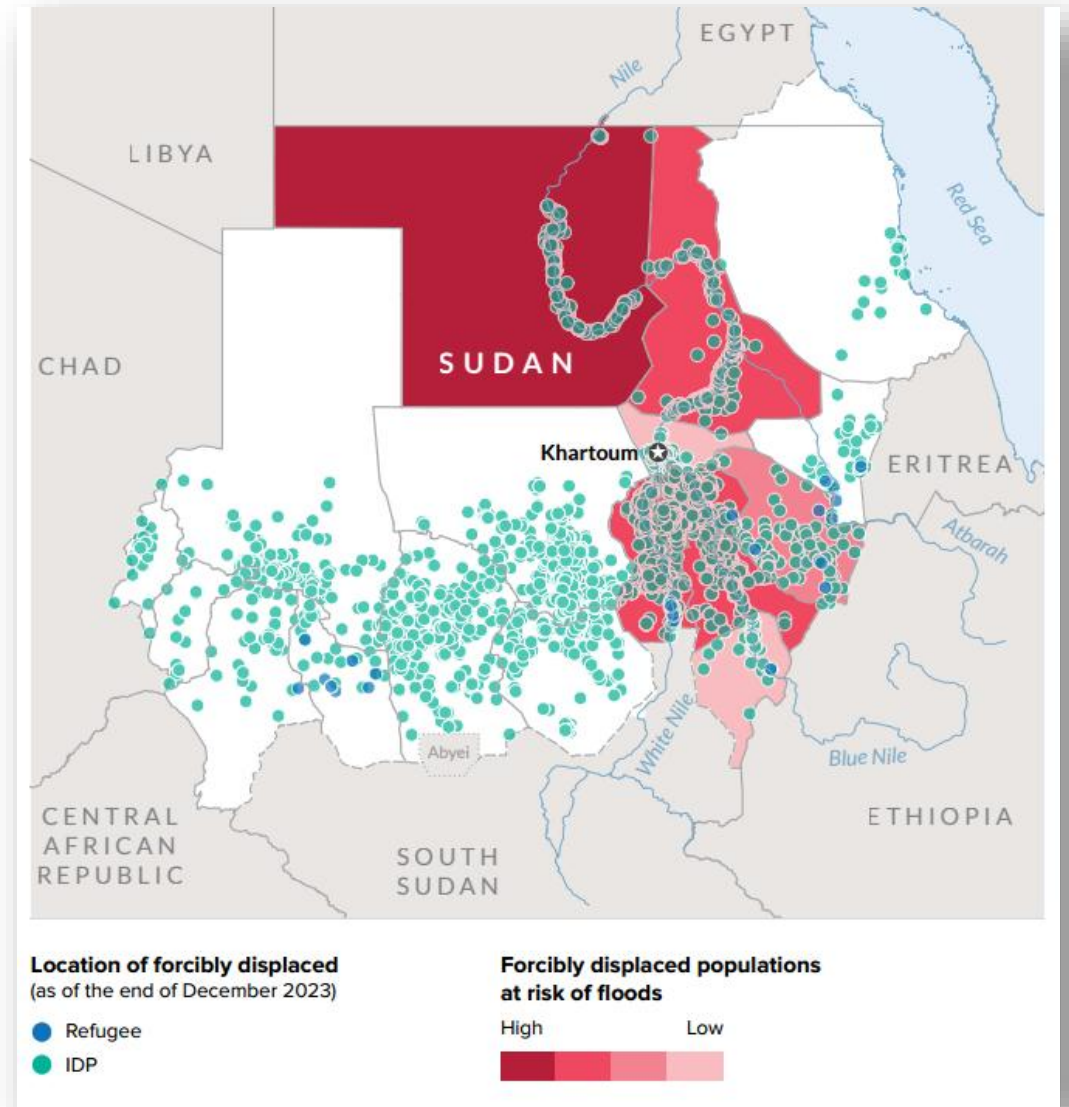
Highly climate vulnerable LDCs and fragile or conflict-affected countries, that are often host or home to large forcibly displaced populations, tend to receive the least average yearly climate finance per capita (2010-2022). Source: UNHCR (2025)



Background

Sudan

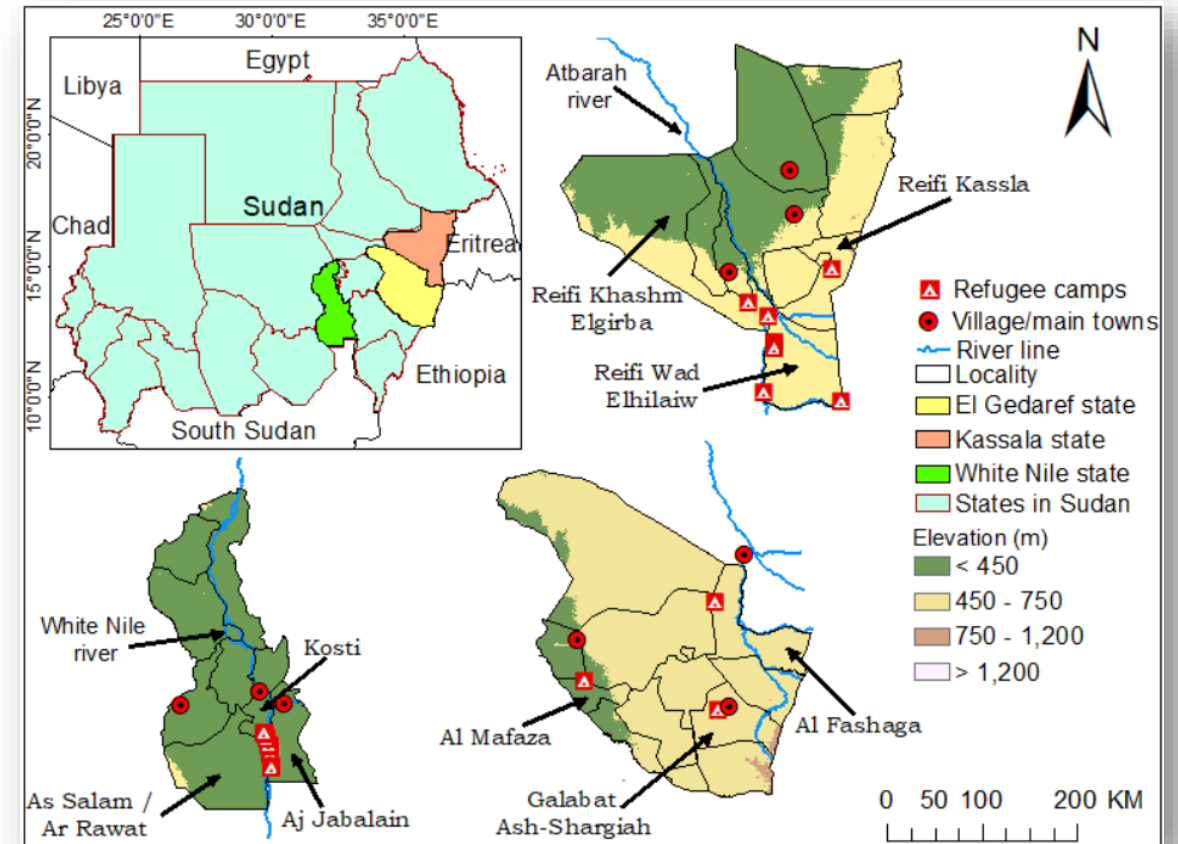
- Fragmented data and limited field access
- Poor visibility of spatial risk variability
- Interventions often not well-targeted
- Need to shift from relief → resilience
- Remote sensing as an enabling tool
- Pathways toward targeted, scalable solutions



Source: UNHCR (2024), No escape: On the frontlines of climate change, conflict and forced displacement. United Nations High Commissioner for Refugees

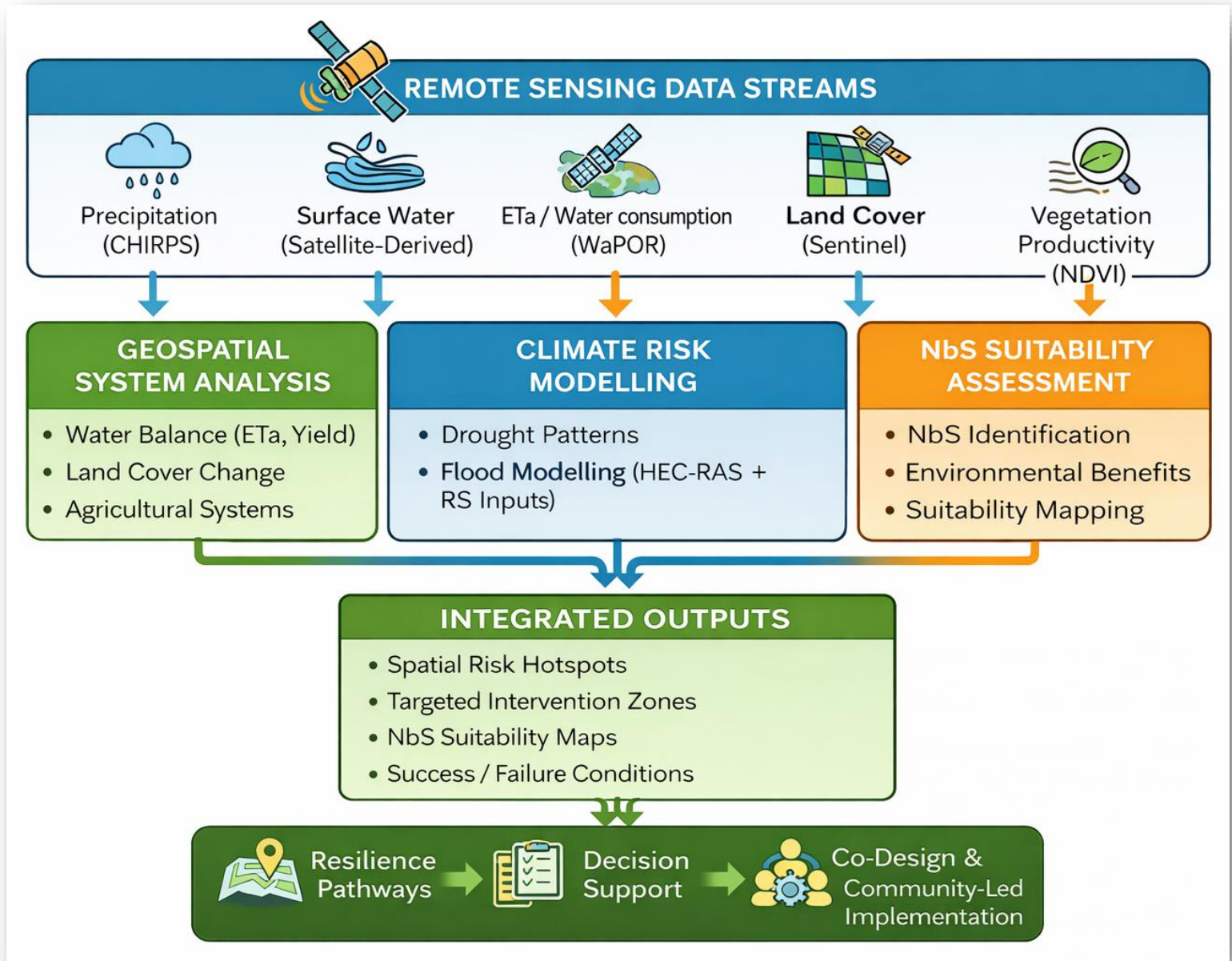
BRIDGE & RENEW Projects

- Geographical focus: Gedaref, Kassala, White Nile
- Key displacement-hosting regions
- Integrated remote sensing approach:
 - Water, climate, agriculture
 - Flood & drought analysis
 - NbS suitability mapping
- Circular Bioeconomy



Source: Mekuria, et al. (2026)

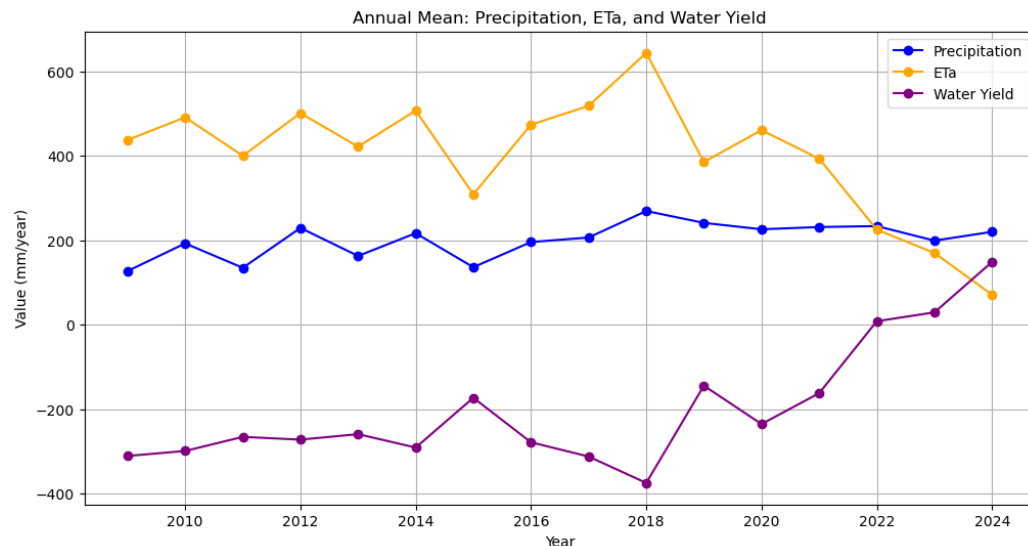
Methodological Approach



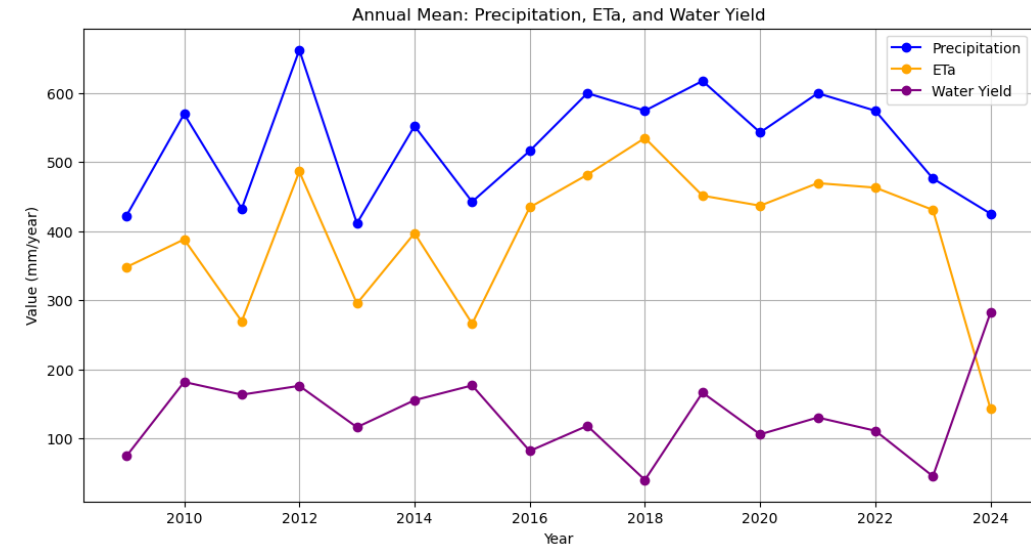
Insights for Resilience Pathways

- Strong spatial variability
- Changes in precipitation & ETa
- Water surplus vs deficit zones
- Decline in vegetation/productivity
- Proxy for conflict impacts

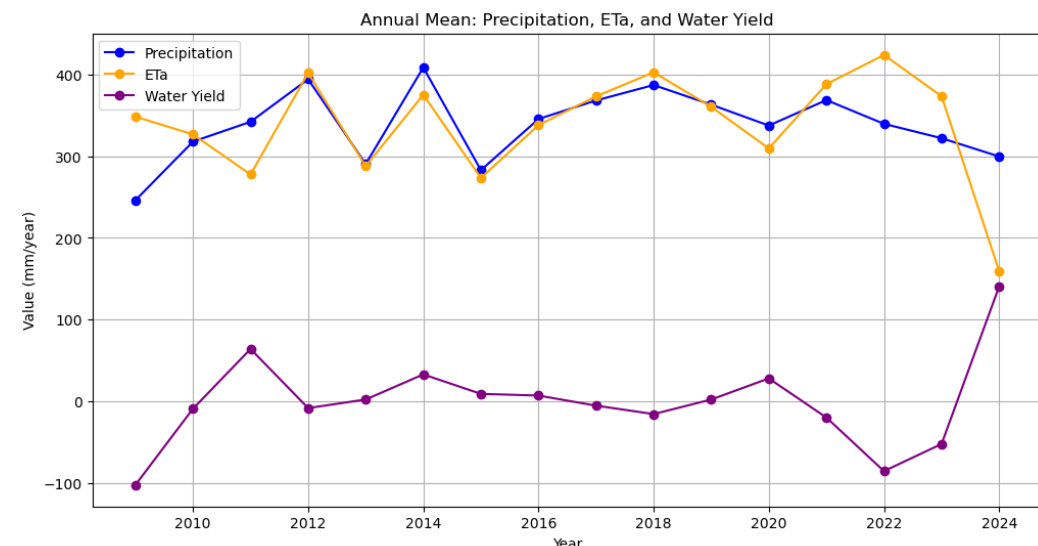
Kassala



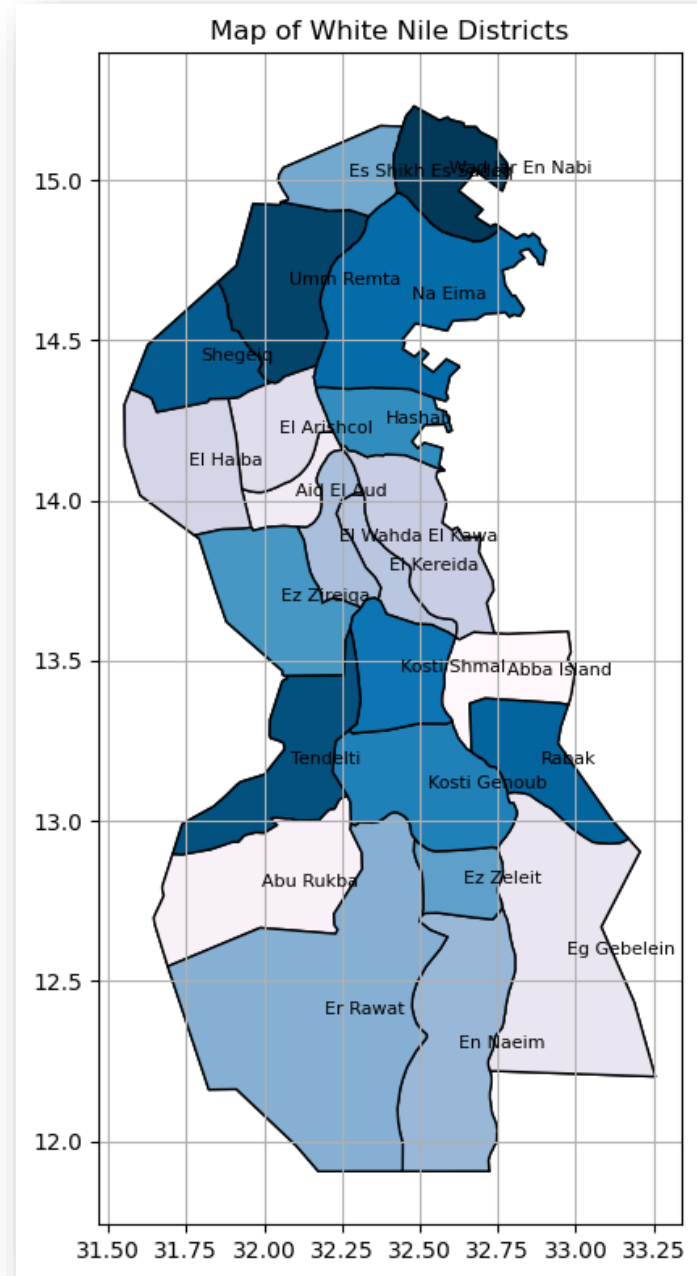
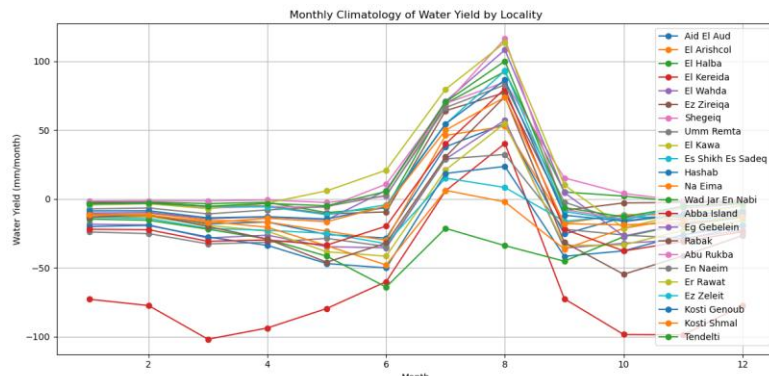
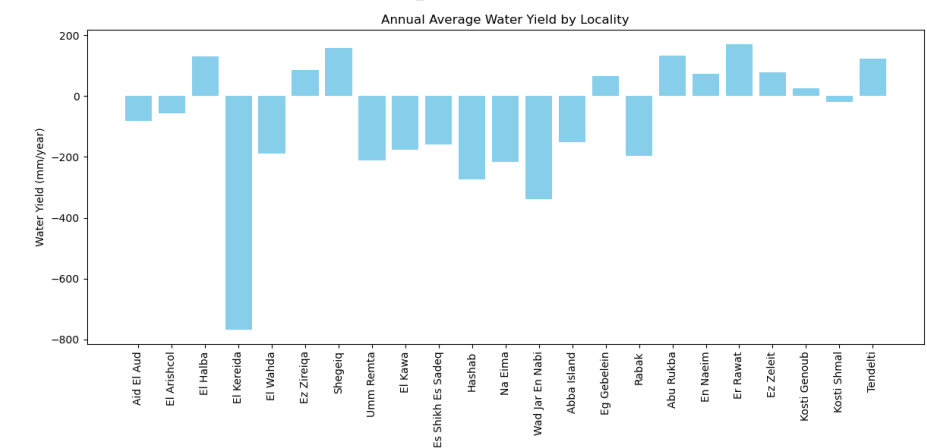
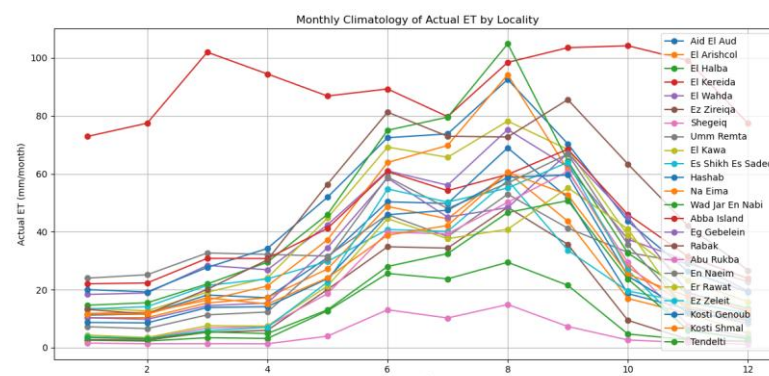
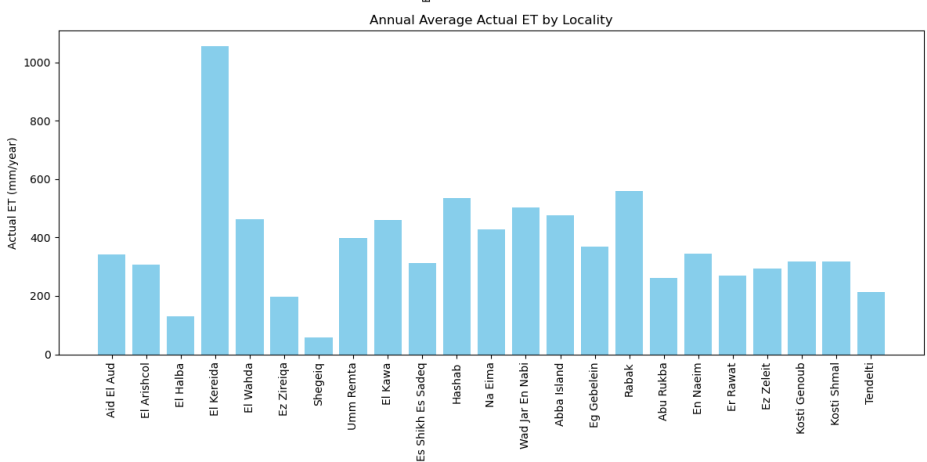
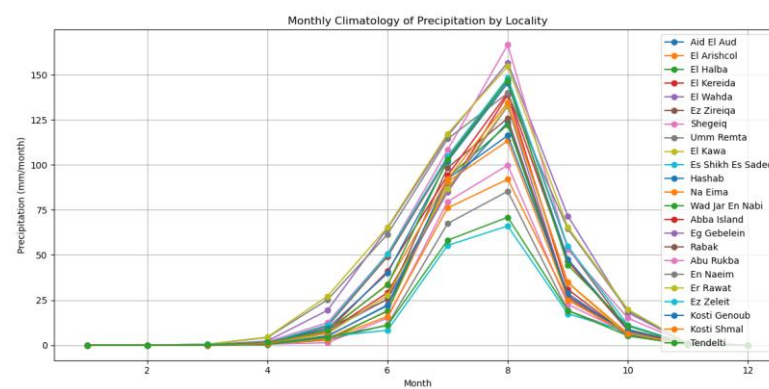
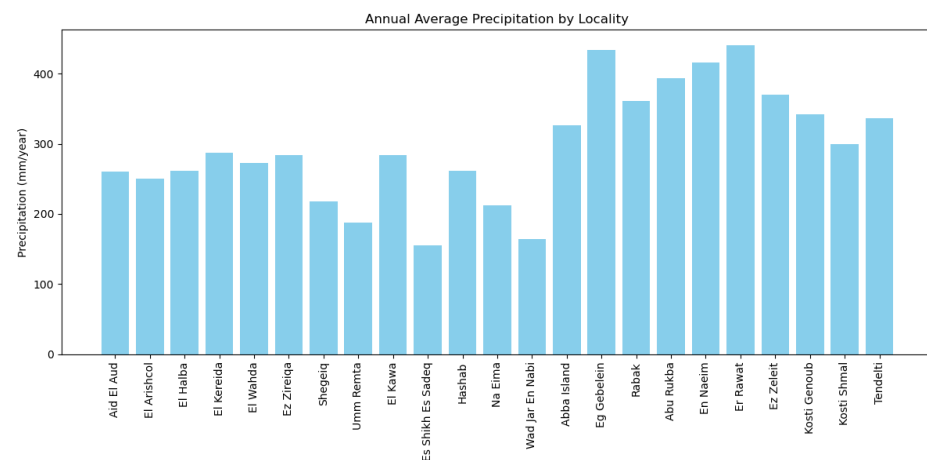
Gedaref



White Nile



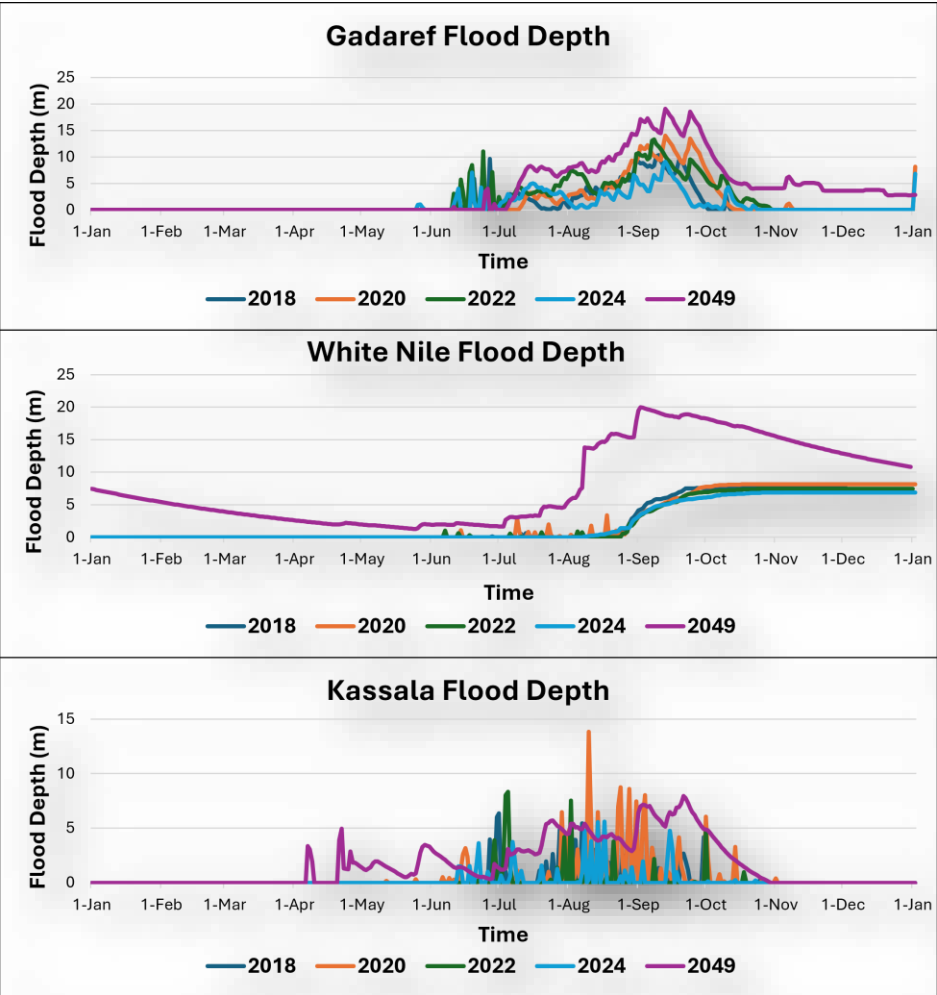
Source: Produced by the authors using CHIRPS and SSEBop ETa datasets.



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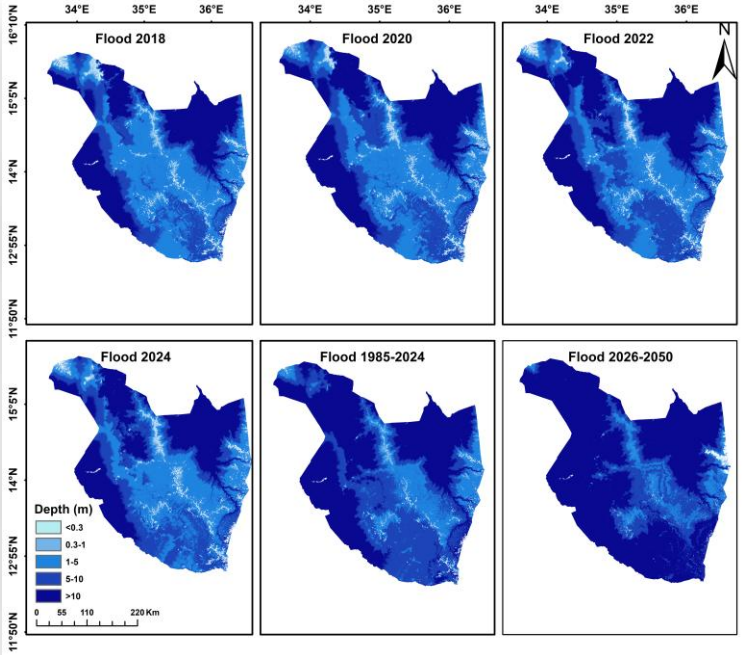
Flood risk trajectories

- Increasing flood intensity
- Expansion of high and severe-risk zones



Variation of flood depth across Gedaref, Kassala, and White Nile states

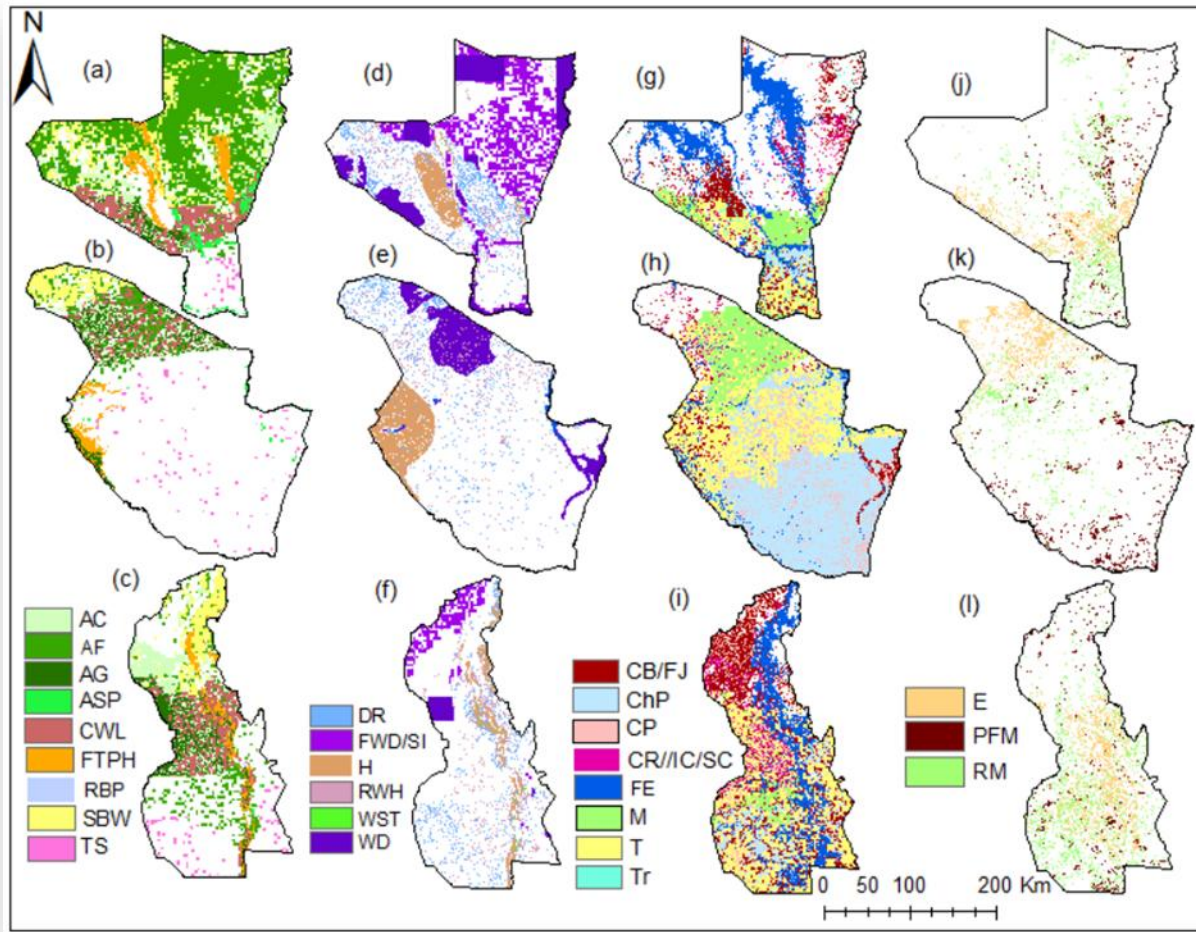
Flood depth maps during the year 2018, 2020, 2022, 2024, and 1985-2024 and 2026-2050 in Gadaref



Gadaref flooded area	2018	2020	2022	2024	Future
Very low flood	503	463	424	448	83
Low flood	1659	1619	1416	1592	214
Moderate flood	25049	22513	19599	21628	5616
High flood	15458	16736	18780	18089	12420
Sever flood	19402	20929	22004	20472	44829

Flood effected area by Severity Class in Gadaref

Nature-based Solutions (NbS)



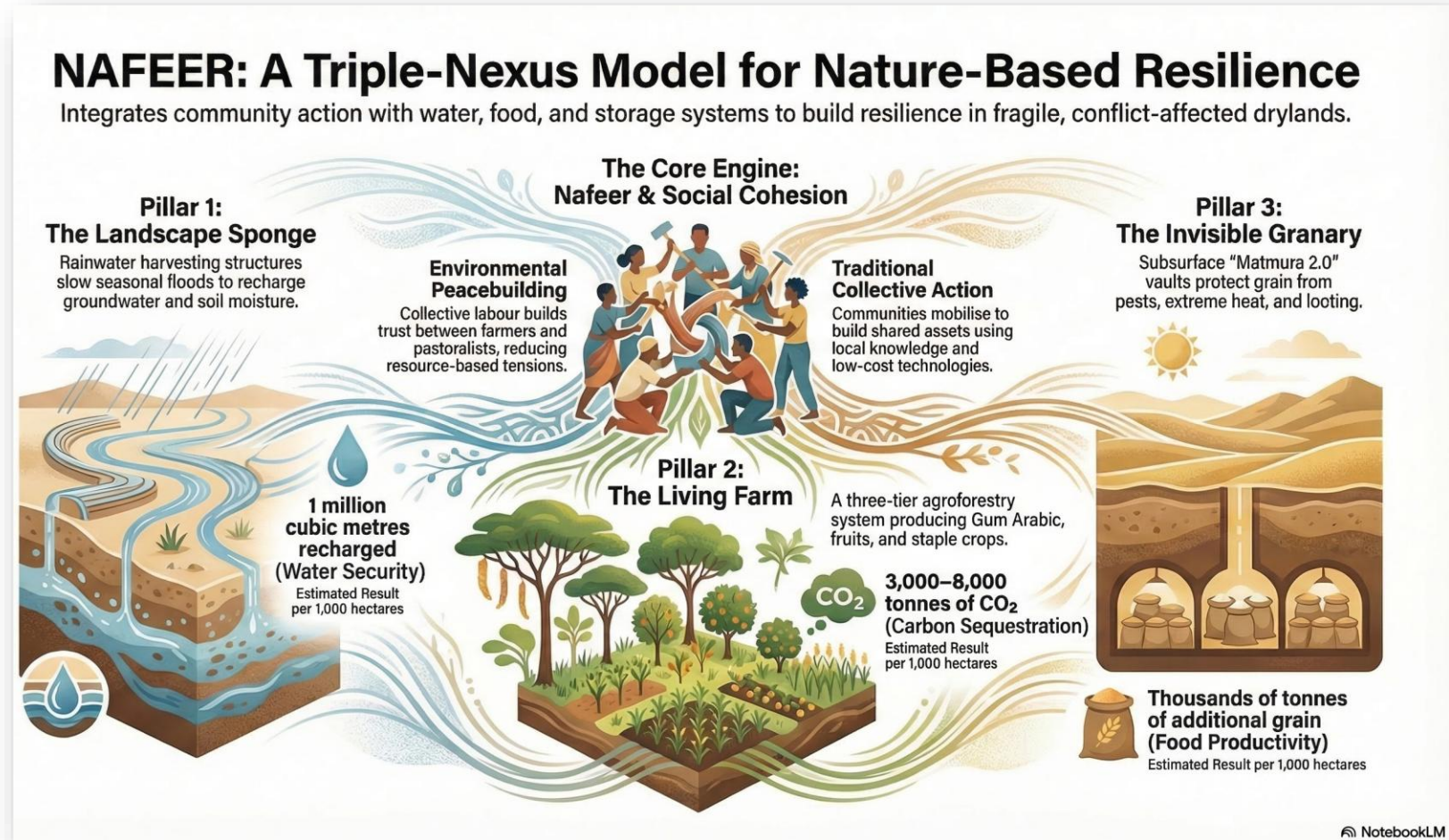
The spatial distribution of suitable areas to implement tree-based resilient nature-based water solutions (a–c), rainwater harvesting and storage (d–f), soil and water conservation (g–i), and ecological restoration (j–l). See the descriptions of the abbreviations in Table 11.

Potential areas (ha) for the identified resilient nature-based water solutions

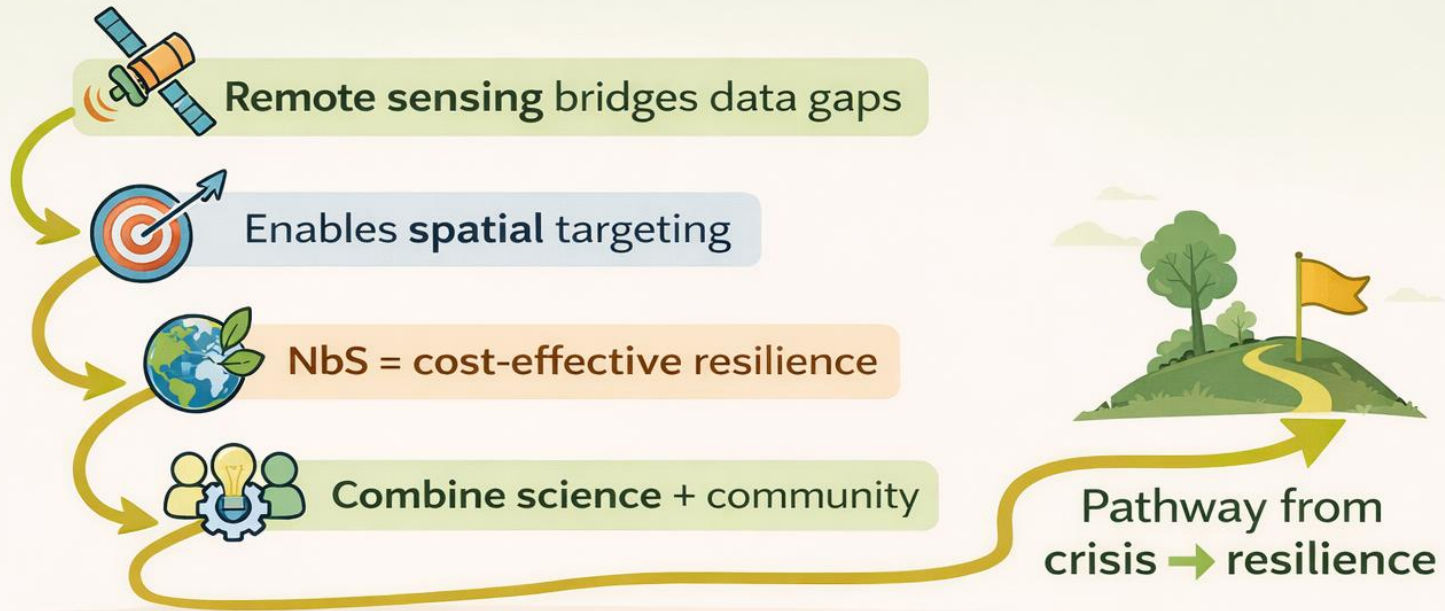
Tree-based resilient nature-based water solutions			
Resilient nature-based water solutions	Kassala	El Gedaref	White Nile
Accacia Senegal plantation (ASP)	120,164	21,568	5,135
Community Woodlots (CWL)	416,351	616,500	372,469
Shelterbelts and windbreaks (SBW)	332,763	245,464	302,978
Agroforestry Parkland Systems (scattered plants on farmlands) (APS)	180,067	304,408	447,317
Taungya Systems (TS)	31,838	98,596	66,758
Fruit tree planting and Homegarden (FTPH)	239,177	162,001	317,131
Alley cropping (AC)	413,899	305,032	681,958
River buffer planting (RBP)	6,467	4,368	5,746
Afforestation (AF)	976,720	510,441	746,662
Rainwater harvesting and storage			
Rooftop water harvesting (RWH)	247,327	196,348	197,116
Haffirs (storage ponds) (H)	263,829	500,967	245,545
Water-Spreading Techniques (WST)	8,464	4,133	8,476
Floodwater Diversion/Spate Irrigation (FWD/SI)	983,909	33,892	219,788
Dams and Reservoirs (DR)	317,525	271,080	241,185
Well digging (WD)	711,086	666,515	90,814
Soil and water conservation			
Terraces (Tr)	108,731	324,808	137,430
Contour bunds, fanya-juu (CB/FJ)	995,755	838,978	737,841
Teras (T)	447,792	919,547	678,021
Flood embankments (FE)	861,344	193,435	969,017
Contour ploughing (CP)	216,347	660,048	412,746
Crop rotation/Intercropping and mixed cropping/ Strip cropping (CR/IC/SC)	123,391	59,042	178,249
Mulching (M)	552,543	983,466	792,068
Chisel Plowing (ChP)	435,512	10,931	762,890
Ecological restoration			
Exclosures (E)	214,127	261,628	434,490
Rangeland management (RM)	288,144	23,737	431,791
Participatory forest management (PFM)	112,882	197,080	124,821

From Analysis to Action

- Co-design and co-implement with communities
- Local knowledge is critical
- Community-led implementation
- Nafeer as core engine
- Ownership → sustainability



FINAL REMARKS



Knowledge products

Technical reports

- Water Data for Fragile Sudan's Water, Food and Environmental systems
- Societal Challenges and Resilient Nature-Based Water Solutions in Refugee-Hosting Areas of Sudan
- Flood Modeling & Climate Data Assessment
- Leveraging Circular Bioeconomy for Resilience in Sudan's Refugee-Hosting Communities

Blogs

- Science helps make humanitarian efforts in Sudan more targeted and sustainable
- Misinformation deepens the impact of conflict and floods in Sudan

Other products

- Water data inventory for fragile Sudan's water, food and environmental systems
- Stakeholder maps





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Thank you!

Muhammad Khalifa

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