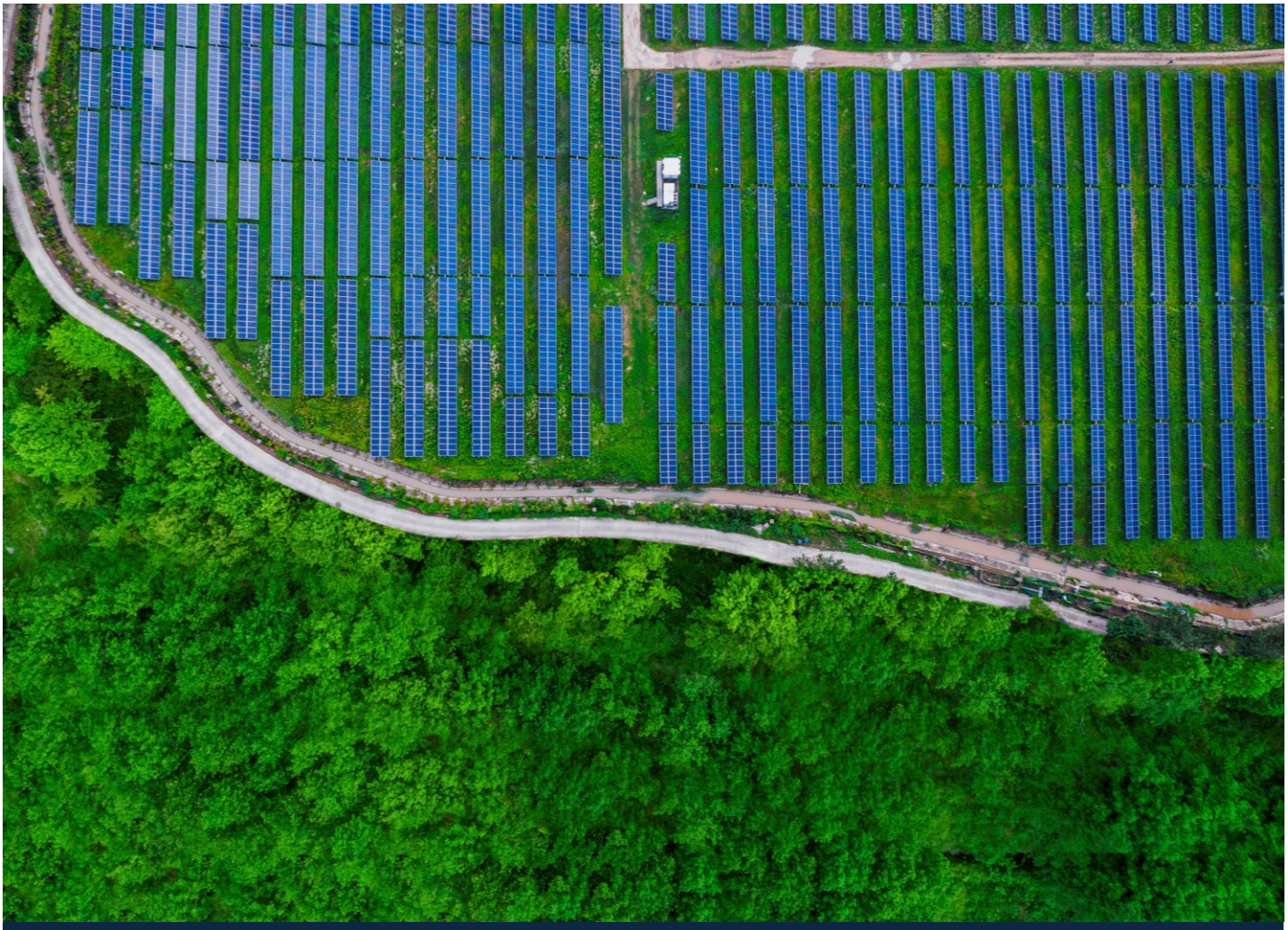
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UN environment programme | CTCN UN Climate Technology Centre & Network



The Water-energy-food-ecosystems (WEFE) Nexus – Technologies and finance to address climate vulnerability in Sub-Saharan Africa

Inter-Agency Policy Brief – April 2026

KEY MESSAGES

- **Climate finance must break silos.** Africa receives only 23% of its NDC investment needs, yet finance continues to flow to the water, energy, and food sectors in isolation, thereby forfeiting critical multiplier effects. Integrated WEFE Nexus financing must become the default approach.
- **The financing gap is structural, not merely quantitative.** Of the USD 2.8 trillion needed by Africa to implement its NDCs by 2030, 85% of commitments are conditional on external support. Domestic capital mobilisation, institutional reform and de-risking instruments are as urgent as headline finance volumes.
- **NDCs are an underutilised vehicle for WEFE integration.** NDC 3.0 cycles present a one-generation opportunity to embed integrated water-energy-food-ecosystems planning into national climate strategies, aligning investment pipelines with development co-benefits.
- **Blended finance and results-based mechanisms are essential.** Green bonds, payment-for-ecosystem-services schemes, and public-private partnerships must be scaled specifically for nexus projects, with standardised multi-sector valuation frameworks to attract institutional investors.
- **Equity and inclusion are non-negotiable.** Climate finance must reach the most vulnerable, including women, youth and smallholder farmers who are both primary resource managers and primary climate victims. Gender-responsive and youth-led financing modalities are prerequisites for lasting WEFE security.

I. Context: The Financing Imperative for an Integrated WEFE Nexus

Sub-Saharan Africa confronts an interlocking set of resource security crises: nearly 600 million people lack access to electricity, 22.3% of the population faces chronic undernourishment, and competition for scarce freshwater is intensifying amid accelerating climate change.[1]

According to reported data, only 31.3% of the Sub-Saharan African population has access to safely managed drinking water (SDG 6.1.1), and the region is collectively moving at just 15% of the pace required to reach universal coverage by 2030. Safely managed sanitation stands at 29.8% (SDG 6.2.1a) and basic handwashing at 28.5% (SDG 6.2.1b), with all three indicators having gained fewer than six percentage points over nine years of measurement.

Electricity access has reached approximately 57% (SDG 7.1.1), a gain of roughly 13 percentage points since 2015, but population growth has kept the absolute number of people without access virtually unchanged. Clean cooking access is perhaps the most severe gap: roughly three in four people across the region still rely on solid biomass as their primary cooking fuel, with the regional average at approximately 25.6% (SDG 7.1.2).

Africa accounts for less than 4% of global cumulative greenhouse gas emissions, yet bears disproportionate climate vulnerability, with average temperatures on the continent rising at approximately twice the global rate.[2]

Hydropower is the backbone of Africa's electricity supply, accounting for 40% of the region's power. However, almost 90% of potential remains untapped – the world's largest proportion of unexploited capacity.

Demand for electricity in Africa is expected to more than triple by 2040, driven by rapid industrialization, rising incomes, rural-urban migration, and climate change. In this vein, Africa is advancing a plan for energy, aligning with the African Union's Agenda 2063 vision for a single electricity market (AfSEM). There is also a continental plan for water investment, but these are not connected plans and do not include assessment of links with water and food security, nor ecosystems to realize synergies.

While Africa is estimated to have 60% of the world's solar resources — it has received only 2% of global investments in renewable energy over the last two decades.[2]

WHAT IS THE WEFE NEXUS?

The Water-Energy-Food-Ecosystems (WEFE) Nexus is a governance and planning framework that recognizes the deep interdependencies among these four resource systems. It moves away from siloed sector management toward integrated approaches that exploit synergies and minimize trade-offs. [7]

Under the Nexus paradigm, line ministries and key sector actors are guided to consider and integrate the priorities of other mandates. Studies applying the WEF Nexus Index to 54 African nations confirm that countries performing sub-optimally in one dimension typically underperform across all three, illustrating the structural interconnectedness of resource insecurity. [8]

By 2050, energy and water demand in Africa are projected to rise by 80% and 55%, respectively, while agricultural production must increase by approximately 50% to meet food demand.[9] Addressing these pressures through integrated finance is not optional; it is existential for sustainable development and building resilience to climate change.

Despite this asymmetry, the continent receives a fraction of global climate finance relative to its needs. Between 2021 and 2022, Africa attracted an annual average of USD 43.7 billion in climate finance[3] - a 48% increase from the 2019/2020 baseline, yet still representing only 23% of what is required to implement existing national climate commitments.[4] The investment shortfall is especially acute for adaptation: only 47% of Africa's climate finance supports adaptation measures, and sub-Saharan Africa relies primarily on overseas development assistance rather than domestic capital or private investment.[5] Critically, international climate finance to developing countries reached USD 196 billion in 2023, with 78% from public actors, a structure that is neither sustainable nor sufficient at scale.

The fragmentation of this finance is as problematic as its insufficiency. Investment in water, energy and food continues to flow through sectoral silos, failing to capture the systemic co-benefits that characterize the Water-Energy-Food-Ecosystems (WEFE) Nexus. For example, a project that installs solar-powered irrigation can simultaneously advance water security, food production,

renewable energy access and ecosystem stewardship, yet standard appraisal methodologies capture only one of these dimensions.[6] Closing the WEFE financing gap, therefore, demands not only greater volumes of capital but a fundamental reorientation of how climate investments are designed, valued and deployed.

SDG Progress as Evidence of Structural Finance Challenge for Water-Energy-Food

The concentration of climate finance mirrors SDG progress inequities. Countries with strong institutional frameworks and integrated planning show consistent improvement across multiple dimensions. Cross-indicator SDG data demonstrates that countries with higher Integrated Water Resources Management (IWRM) implementation scores (SDG 6.5.1) and stronger transboundary cooperation (SDG 6.5.2) tend to show better outcomes across water, energy, and food dimensions simultaneously.

This cross-indicator consistency suggests that institutional capacity and integrated planning amplify the impact of each dollar of finance received.

Table 1 below aggregates these cross-sectoral achievements against SDG 6 and 7 indicators, detailing the top five performing Sub-Saharan African countries according to reported data over the last ten years. By tracking their frequency of appearing in the top regional quintiles in SDG 6 and SDG 7 indicators, the table provides comparative look between progress and financing.

Table 1: Top Sub-Saharan African Countries Progressing by SDG 6 & 7 Indicator Rankings[1]

		Top-5 Classification (count)		SDG split		ODA & finance flows (latest, USD M)	
No.	**Country**	**Progress (2015**-2024)**	**Latest Result**	**SDG 6**	**SDG 7**	**6.a.1 (water)**	**7.a.1 (energy)**
1	**Rwanda***	7	7	11	3	86.0	315
2	**South Africa**	5	9	10	4	9.2	935
3	**Benin**	8	4	9	3	66.4	23.4
4	**Mauritius**	3	9	7	5	66.2	3.7
5	**Tanzania**	7	4	8	3	297	558

Source: Author's analysis based on data from the UN SDG Global Data Portal (SDG 6 and 7), available at: unstats.un.org/sdgs/dataportal. Note: **Rwanda: reported 6.1.1 data is urban-only; reported 6.2.1a data is rural-only. ** ≥2015*

Rwanda, for instance, ranks in the top three for progress on drinking water, sanitation, IWRM implementation, transboundary cooperation, and electricity access, and is the only country in the region approximately on track for universal electricity access by 2030.[2]

South Africa, similarly, ranks at the top for current absolute infrastructure capacity across multiple water and energy dimensions, yet exhibits a stark financing imbalance that heavily favors clean

[1] Note: Countries are scored by their regional "Top 5" appearances across 18 SDG 6 and 7 indicators. *Progress* reflects the frequency of top five in progress ranking from baseline (≥2015) to the latest year (≤2024), while *Latest Rank* denotes the highest absolute progress achieved across all SDG 6 & 7 indicators based on the latest data reported. To contextualize these achievements against financial inflows (USD Millions): *SDG 6.a.1* represents the latest ODA for water and sanitation (UN Statistics Division); *SDG 7.a.1* represents 2023 international clean-energy finance (OECD CRS/IRENA).

[2] Based on authors' analysis of latest reported data from Sub-Saharan African countries on https://unstats.un.org/sdgs/dataportal/database

energy over water and sanitation assistance. Overall, South Africa achieved progress in SDGs 6 and 7

Benin, by contrast, ranks third overall for its rapid pace of advancement across both water and energy sectors, and demonstrates how efficient integrated governance can effectively amplify the impact of comparatively modest climate finance.

By contrast, countries like South Sudan, Chad, and the Central African Republic remain near the bottom across virtually all water, energy, and food indicators, receiving among the least climate finance despite facing the greatest vulnerability. However, there is hope with new programmes from climate institutions prioritizing Member States like Chad according to recent initiatives.[3] These estimates also rely on reported data which may have gaps and mask progress as well as challenges in the region.

The Structural Barriers to WEFE Finance

Existing research identifies four interconnected barriers that prevent climate finance from flowing to WEFE Nexus projects at scale:

- **Institutional fragmentation.** Only a minority of sub-Saharan African countries have achieved meaningful integration among the ministries of water, energy, food, and environment. The majority maintain separate budget lines, institutions, planning cycles and donor relationships for each sector, making it structurally difficult to design, approve or track integrated investments.[10]
- **Valuation failures.** Traditional investment appraisal tools capture single sector returns while ignoring co-benefits and spillover effects across the nexus. A solar irrigation project that simultaneously reduces diesel use, increases crop yields, reduces aquifer depletion, and sequesters carbon will typically be evaluated solely on its energy cost savings. Developing integrated valuation methodologies that reflect the full cost-benefit spectrum of nexus interventions is crucial for attracting investors and policymakers. [11]
- **Risk perception and transaction costs.** Multi-sector projects are perceived as higher-risk by private investors due to cross-jurisdictional governance requirements, institutional fragmentation and the absence of standardized project typologies. High transaction costs in project preparation and blended finance structuring disproportionately disadvantage smaller or more fragile economies.[12]
- **Stagnating international development finance**. Official development assistance for water and sanitation (SDG 6.a.1) has been essentially flat in real terms since 2015, with the regional average per country hovering near USD 58 million annually, while both population and service deficits have grown.
- **Debt distress and limited domestic capital mobilization.** With sovereign debt levels rising across the region, the fiscal space for public climate investment is constrained. While Africa holds approximately USD 2.4 trillion in domestic bank, insurance and pension assets, tapping these resources requires building capacity, data systems and regulatory frameworks to channel institutional capital toward climate-aligned WEFE investments.[4] Domestic capital mobilization is a complement to scaled-up international finance for the SDGs when directed towards basic services.

[3] https://www.greenclimate.fund/news/green-climate-fund-announces-commitment-mobilise-usd-100-million-chad

II. The Climate Finance Landscape: Flows, Gaps and Inequities

Climate finance to sub-Saharan Africa has grown significantly in recent years, reaching over USD 50 billion annually for the first time in 2022. [3] However, the aggregate figures conceal profound structural inequities. International finance remains heavily concentrated: the top ten recipient countries in Africa capture 46% of total funding, while the ten countries most vulnerable to climate impacts receive only 11% of total flows.[4] This inversion, in which the most climate-exposed nations receive the least finance, reflects persistent barriers to access rooted in governance capacity, country risk ratings, and mismatches between donor preferences and recipient priorities.

In 2023, for the first time, annual contributions to climate finance from private sources exceeded USD 1 trillion, outpacing public investment. [4] International climate finance to developing countries reached USD 196 billion in 2023, with 78% from public actors. Sub-Saharan Africa primarily relied on overseas development assistance (ODA in climate finance)[4]. Figure 1 shows the increase in climate finance over the last few years by region, with sub-Saharan Africa visibly in need of greater financing compared to other regions especially given its level of climate vulnerability.

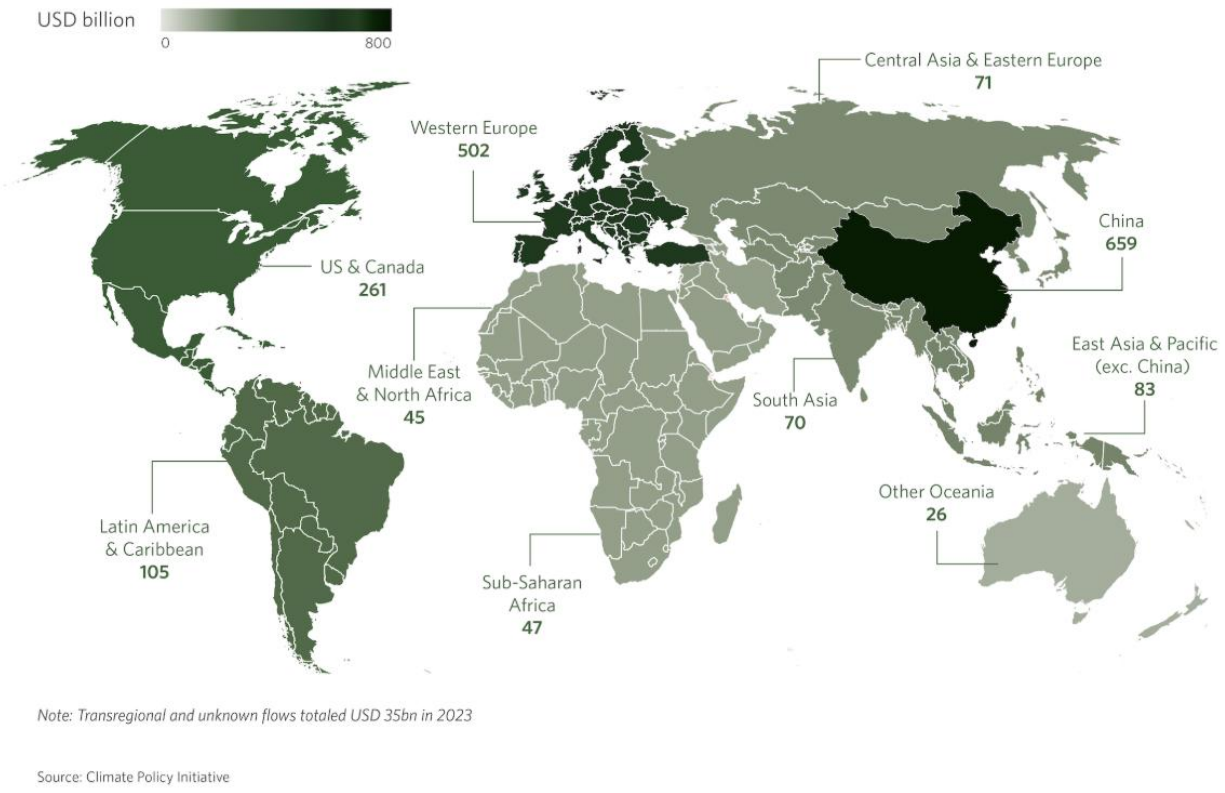


Figure 1. Increase in climate finance by region (2023)

The financing instruments available to sub-Saharan African governments are also structurally skewed. Debt dominates adaptation financing, with 57% of adaptation funds arriving in loan form, the majority concessional but some at near-commercial rates.[5] As Africa's external debt outpaces

[4] https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2025/

GDP growth, reliance on loans raises sustainability concerns and increases the risk of debt distress, particularly for least developed countries. With roughly 20% of African countries now spending over 25% of revenue on debt interest alone and several (e.g. Ghana, Zambia, and Kenya), allocating more to debt service than to health or education, recurrent fiscal obligations are crowding out the development expenditure most needed for closing the infrastructure gaps essential for water, energy and food security. South Africa's 2023/24 budget expenditure review shows that 15% of total public expenditure went to debt servicing while 12% went to health expenditures.

Development finance and climate finance are insufficient to meet current challenges, requiring more efficiency in domestic resource mobilization and fiscal consolidation. The COP29 outcome in November 2024 established a New Collective Quantified Goal (NCQG) of USD 300 billion per year by 2035 for developing countries [13]. Yet, this figure falls well short of the estimated USD 1.3 trillion required annually for the global low-carbon transition. [14] For Africa alone, nearly USD 3 trillion is needed between 2020 and 2030 to implement NDC commitments (USD 277 billion annually) of which 85% is conditional on external finance not yet pledged.[15] In this context of constrained fiscal space, the WEFE Nexus offers a pathway to greater fiscal efficiency and optimization of constrained public budgets, integrating water, energy, food, and ecosystem investments to maximize impact per dollar spent and ease the pressure on overstretched public budgets.

Sectoral Allocation Patterns and the Case for Integration

Current climate finance flows to sub-Saharan Africa are dominated by mitigation investments, particularly in the energy sector, with adaptation and cross-sectoral investments significantly underfunded. An estimated 64% of the climate finance Africa requires is dedicated to mitigation. In comparison, 36% is earmarked for adaptation, yet adaptation needs, particularly in agriculture, water resources management and ecosystem protection, are both more immediate and more structurally connected to poverty reduction. [15]

The sectoral siloing of finance is particularly evident in sub-Saharan Africa's energy-water nexus. Hydropower provides 40% of Africa's electricity supply. Yet, the sector's dependence on adequate water flows creates a fundamental vulnerability: climate-induced changes in precipitation patterns simultaneously undermine energy generation capacity and reduce agricultural water availability. [1] Finance that treats energy and water investments as separate lines fails to manage these systemic interdependencies or unlock the adaptation co-benefits that integrated planning could provide.

Solar energy illustrates the inverse opportunity. Africa possesses 60% of the world's solar resources but has attracted only 2% of global renewable energy investment over the past two decades. [16] Solar-powered irrigation, agrivoltaic systems and decentralized mini-grids simultaneously advance energy access, water efficiency, food production and women's economic empowerment — yet these technologies remain chronically underfunded relative to their development potential. Scaling these nexus technologies requires finance structured to capture and reward their multi-dimensional returns.

Table 2. Climate Finance Status and WEFE Nexus Integration in Selected Sub-Saharan African NDCs *(See annex for full table)*

Country	NDC WEF Integration	Key Nexus Commitments	Finance Status	Priority Gaps
Ethiopia	High	Dam construction, solar irrigation, watershed management	GGGI solar irrigation project is active; Significant international climate finance, supplemented by the USD 50M FP243 Safe Water Renewable Energy nexus pilot[5] , the USD 463M P156433 Urban WSS project[6], the USD 50M FP058 Drought Resilience initiative[7], and the GEF 10478 Mini-grids program[8]	Cross-border water finance, equity in rural access. Handwashing access declining (SDG 6.2.1b, -2.6 pp); only 8.1% safely managed sanitation, underscoring persistent rural service gaps.
Kenya	Moderate	Safe water access for 50% of the population by 2030; geothermal expansion	Strong private sector; M-KOPA off-grid solar scaled regionally Supported by multi-source financing for Menengai Geothermal[9], the P160009 Off-grid Solar Access Project[10], the USD 10M FP175 Upper Athi Water Security project[11], and GIZ-led Climate-Friendly Cooking market development[12]	WEFE integration in NDC planning; smallholder finance Ambient water quality (SDG 6.3.2) collapsed from 86.5% in 2020 to 37.05% in 2023; water stress (SDG 6.4.2) rose +6.6 pp since 2015). indicating incomplete WEFE integration.
Niger	High	Solar irrigation, water harvesting, agrivoltaics pilot	Constrained by fragility; RETO-DOSSO pilot	Scale-up capital; governance and risk frameworks

[5] https://www.greenclimate.fund/project/fp243
[6] https://projects.worldbank.org/en/projects-operations/project-detail/P156433?lang=en
[7] https://www.greenclimate.fund/project/fp058
[8] https://www.thegef.org/projects-operations/projects/10478
[9] https://www.afdb.org/en/projects-and-operations/selected-projects/the-menengai-project-kenya-pioneering-geothermal-development-in-east-africa-108
[10] https://www.worldbank.org/en/news/loans-credits/2017/07/26/kenya-off-grid-solar-access-project-for-underserved-counties
[11] https://www.greenclimate.fund/project/fp175
[12] https://www.greenclimate.fund/project/fp103

Country	NDC WEF Integration	Key Nexus Commitments	Finance Status	Priority Gaps
			demonstrates proof of concept	
Rwanda	High	52% grid; 48% off-grid target; solar cold chain	ACES solar cold chain active; strong policy environment	Ecosystem services finance; watershed investment
Nigeria	High	Renewable energy expansion; water infrastructure; Em-Hydro pilot	Large domestic capital pool; Significant ODA recipient, supplemented by the active USD 495.3 million P123112 Transforming Irrigation project focusing on drainage and Integrated Water Resources Management (IWRM)[13].	Private sector mobilization; community-level WEFE finance Wastewater treatment (SDG 6.3.1) declined from 48.3% in 2020 to 40.7% in 2024; ODA for water (SDG 6.a.1) roughly halved from 223.437407 (USD_M) in 2015 to 130.359901 (USD_M) in 2023
South Africa	High	Just Energy Transition; Durban water recycling; conservation agriculture	JETP USD 8.5bn; ZAR 188bn tracked annually; adaptation severely underfunded. However, adaptation efforts are being bolstered by the USD 1.5 billion FP209 SA Water Reuse Programme[14], which targets wastewater treatment and circular water economies.	Adaptation finance; just transition equity; water-energy integration Wastewater treatment (SDG 6.3.1) collapsed from 61.3% in 2020, to 21.6% in 2024; IWRM implementation score (SDG 6.5.1) declined (65% to 60%); drinking water declining (-3.2 pp); and water stress (SDG 6.4.2) increased from

[13] https://documents.worldbank.org/en/publication/documents-reports/documentdetail/291081524757909915
[14] https://www.greenclimate.fund/project/fp209

Country	NDC WEF Integration	Key Nexus Commitments	Finance Status	Priority Gaps
				59.75% in 2015 to 67.6% in 2022.
Senegal	High	Renewable energy; sustainable agriculture; integrated resource management	Emerging private sector; multilateral support through WAEMU frameworks, bolstered by the GCF/BOAD FP138 off-grid solar project[15] targeting 1,000 villages, the USD 130 million P164262 Rural WSS project[16] (closed in 2024), and GIZ-led Climate-Friendly Cooking initiatives[17].	Domestic capital mobilization; food system investment

Sources: CPI Landscape of Climate Finance in Africa 2024; UNDP Climate Finance in Africa 2024; country NDC submissions; UNOSD analysis; GCF Projects & Programmes; World Bank Projects & Operations; GEF Projects & Operations

III. Nationally Determined Contributions as Vehicles for WEFE Finance

Nationally Determined Contributions represent the primary formal mechanism through which countries articulate their climate goals, signal investment priorities and communicate finance needs to bilateral and multilateral partners. As countries prepare NDC 3.0 submissions through 2025, they face a structural choice: whether to deepen existing sectoral commitments or seize the opportunity to embed integrated WEFE Nexus frameworks into their national climate architectures.

Research on African NDC quality confirms that, while a growing number of countries reference water-energy-food interlinkages in their submissions, few have operationalized these connections with specific integrated targets, financing mechanisms or cross-ministerial accountability structures.[17] Nowack et al. (2024) find that African NDCs and National Adaptation Plans often lack sufficient information for effective adaptation tracking, due to partial coverage of the adaptation cycle and inconsistencies across components.[5] This undermines the ability of development finance institutions and private investors to align capital with country priorities.

Analysis of the 48 sub-Saharan African NDC submissions reviewed for this brief reveals that while 26 countries demonstrate high or moderate WEF nexus integration in their commitments, only a minority have established specific integrated financing targets or cross-sector implementation

[15] https://www.greenclimate.fund/project/fp138
[16] https://projects.worldbank.org/en/projects-operations/project-detail/P164262?lang=en
[17] https://www.greenclimate.fund/project/fp103

mechanisms. Countries like Ethiopia and Sudan demonstrate strong integration with specific dam-to-solar pathways and renewable energy targets for the water sector, while others remain at the early stages of incorporating WEF considerations.

Strengthening NDC Integration: Evidence and Good Practice

Evidence from the 2025 Workshop on Accelerating the WEFE Nexus in Sub-Saharan Africa[18] and the UNOSD/UNU INWEH policy brief (2025)[10] identifies several design principles for NDCs that can catalyze WEFE-aligned climate finance:

- **Quantified nexus targets.** NDCs with specific, measurable WEFE targets, such as Rwanda's 52%/48% grid/off-grid split linked to agricultural connectivity, provide investable frameworks that development finance institutions can anchor in project pipelines.
- **Cross-sector budget alignment can strengthen SDG finance links.** Where NDC commitments are matched to medium-term expenditure frameworks across water, energy and agriculture ministries, the probability of implementation increases and aligns with SDG financing as well. South Sudan's inclusion of hydropower at Fulla Rapids alongside solar and wind projects demonstrates integrated energy-water planning at the NDC level. NDC submissions would benefit from aligning with SDG indicator benchmarks to align with climate and SDG finance.
- **Costed adaptation components.** Only a minority of African NDCs include well-costed adaptation plans despite adaptation needs being as large or larger than mitigation requirements. Costed adaptation plans provide the evidentiary basis for accessing adaptation finance from the Green Climate Fund, Adaptation Fund and bilateral sources.
- **Ecosystem services integration.** Including payment-for-ecosystem-services frameworks and nature-based solutions in NDCs enables countries to access emerging carbon market and biodiversity finance streams, linking WEFE nexus goals to new revenue mechanisms.

IV. Financing Instruments for the WEFE Nexus

Financing WEFE Nexus projects requires a portfolio of instruments calibrated to different risk profiles, development contexts and investment scales. No single financing tool is sufficient, requiring complementary tools is needed to address the full range of barriers identified in Section I. The following instruments are recommended for Sub-Saharan Africa:

1. Blended Finance and De-risking Structures

Blended finance, the strategic use of concessional public funds to mobilize private capital, has emerged as a central mechanism for closing climate investment gaps in developing economies. In 2024, total private climate finance globally exceeded USD 1 trillion for the first time, demonstrating the mobilizing potential of blended structures.[12] For WEFE Nexus projects specifically, blended approaches can address the perceived risk premium associated with multi-sector investments by providing first-loss capital, currency hedging and political risk insurance through development finance institutions.

The Convergence Finance State of Blended Finance report (2024) confirms that critical gaps remain in adaptation finance and in the mobilization of private capital for climate resilience

projects, precisely the categories most relevant to WEFE nexus investments.[19] Operationally, blended finance facilities for WEFE investments should be structured around: (a) concessional first-loss tranches provided by multilateral climate funds; (b) mezzanine financing from development finance institutions such as the African Development Bank, IFC and bilateral DFIs; and (c) senior commercial debt and equity from institutional investors attracted by de-risked instruments.

2. Green Bonds and Sustainability-Linked Finance

Green bonds and sustainability-linked instruments offer a mechanism to channel institutional capital toward WEFE Nexus projects at scale. For these instruments to function effectively in sub-Saharan Africa, standardized WEFE project taxonomies are needed that define eligibility criteria, reporting requirements, and impact metrics for integrated water-energy-food investments. South Africa's development of a Green Finance Taxonomy (2025) provides a national-level model, though its current adoption rate and international interoperability require strengthening.[20]

Sustainability-linked bonds, where coupon rates are tied to WEFE performance indicators (e.g., hectares of solar irrigation deployed, reduction in diesel pump usage, increase in agricultural water productivity), provide investors with credible signals of development impact while incentivizing governments and utilities to meet integrated targets. Regional green bond markets, coordinated through the African Development Bank's African Financial Markets Initiative and existing regional economic communities, could reduce transaction costs and aggregate project pipelines to investment-grade scale.

3. Payment for Ecosystem Services (PES) and Results-Based Finance

Payment-for-ecosystem-services frameworks provide a mechanism to finance the often-invisible services that healthy ecosystems provide to water, energy, and food production systems: watershed protection for hydropower, soil carbon sequestration for agricultural productivity, and wetland regulation for flood management. PES schemes link beneficiaries such as utilities, agribusinesses, and municipalities, to the farmers and communities that maintain the ecosystems on which they depend, creating direct financial flows from downstream beneficiaries to upstream land stewards.[11]

Results-based climate finance mechanisms, including those operated through the Climate Investment Funds, REDD+ and the FCPF Carbon Fund, also hold potential for WEFE Nexus scaling. However, access barriers for small and fragile economies remain significant: project preparation costs are high, results measurement frameworks are complex, and disbursement timelines are long. Streamlining access modalities and investing in country-level measurement and verification capacity are prerequisites for results-based finance to reach its potential in sub-Saharan Africa.

4. Public-Private Partnerships for Nexus Infrastructure

Well-structured public-private partnerships (PPPs) can mobilize private capital for WEFE infrastructure that generates revenue streams adequate to service commercial debt. Solar-powered irrigation systems with pay-as-you-go models (exemplified by M-KOPA in East Africa and Bboxx across multiple countries), decentralized renewable energy mini-grids, and solar-

powered cold chain infrastructure for agricultural value chains all demonstrate viable PPP archetypes. [1]

Key design principles for WEFE Nexus PPPs in sub-Saharan Africa include: matching risk allocation to each party's comparative advantage (governments absorbing political and regulatory risk; private operators managing technical and commercial risk); ensuring community benefit-sharing arrangements that maintain social license; and structuring output-based aid mechanisms that subsidize service delivery to poor households while maintaining commercial viability for operators. The GIZ model of combining technical WEFE nexus guidance with microfinance instruments specifically designed for nexus solutions provides one replicable archetype. [21]

Table 3. Comparative Evaluation of Financing Instruments for WEFE Nexus Projects

Instrument	Scale Potential	Risk Profile	Speed to Deployment	Fragile State Applicability	Primary Challenge
Blended Finance Facilities	High	Medium	Medium	Moderate	High transaction costs; project pipeline development
Green Bonds	High	Low-Medium	Slow	Low	Requires taxonomy, credit rating, and institutional investor base
Payment for Ecosystem Services	Medium	Low	Slow	High (community-led)	Valuation, monitoring and enforcement capacity
Public-Private Partnerships	Medium-High	Medium	Medium	Moderate	Regulatory frameworks; political risk; equity safeguards
ODA / Concessional Loans	High (current)	Low	Medium	High	Debt sustainability; conditionality; long procurement cycles
Carbon / Article 6 Markets	Emerging	Medium	Slow	Low-Moderate	Baseline integrity; permanence; co-benefit verification
Domestic Institutional Capital	Latent	Medium	Slow	Variable	Regulatory frameworks; risk perception; capacity

Adapted from Frontiers in Sustainable Resource Management (2025); CPI Landscape of Climate Finance in Africa 2024; OECD Development Finance data.

V. WEFE Nexus Financing Challenges in Sub-Saharan Africa

Energy-Water-Food Interdependencies Under Climate Stress

Hydropower generates 40% of Sub-Saharan Africa's electricity supply, yet 90% of exploitable capacity remains untapped. [22] The continent's electricity access rate has improved from 44% to 59% since 2010, but rapid population growth has kept the absolute number of people without electricity virtually unchanged at 591 million in 2022. [23] Demand for electricity is projected to more than triple by 2040, driven by industrialization, urbanization and climate-related cooling needs, creating a scenario in which a largely hydropower-dependent grid faces growing water stress at the same time.

SDG tracking data quantifies this uneven progress. Electricity access gains vary enormously: Rwanda gained 41.1 percentage points between 2015 and 2023, while Somalia declined by 0.9 percentage points. Meanwhile, water stress (SDG 6.4.2) is worsening in several key economies: Cabo Verde moved from the low-stress to the medium-stress band (+22.4 percentage points), Zimbabwe's stress rose from 31.9% to 46.1%, and South Africa's from 59.8% to 67.6%.[18]

A further complexity is the "biomass paradox" in renewable energy statistics. Sub-Saharan Africa shows very high measured renewable energy shares (SDG 7.2.1), typically 60–95%, because the indicator classifies traditional biomass (firewood, charcoal, crop residues) as renewable. A declining renewable share may actually signal a positive energy transition as households shift from biomass to electricity or LPG. WEFE finance strategies must account for this statistical artefact: policies that successfully reduce biomass reliance, improving clean cooking and reducing deforestation, will paradoxically appear to reduce "renewable" energy share in the statistics. Installed renewable capacity (SDG 7.b.1), which tracks modern renewables, is a more reliable metric of clean energy progress and is growing at 12.4% CAGR regionally.[19]

Agriculture accounts for approximately 80% of water withdrawals in Sub-Saharan Africa. [1] As electricity access expands, without strong WEFE governance frameworks, there is a real risk that increased electrification enables more intensive groundwater extraction for irrigation without corresponding efficiency gains. The WEF Nexus Index applied to Nigeria, Uganda and South Africa demonstrates this risk in concrete terms: expanding energy access without corresponding water governance improvements is likely to intensify rather than resolve food-water security trade-offs. [24]

Climate change compounds these dynamics. Projections for Sub-Saharan Africa indicate that rising temperatures, shifting precipitation patterns and increased frequency of extreme events will simultaneously reduce hydropower generation capacity, reduce rainfed agricultural yields, and increase water demand for both agriculture and cooling. This triple exposure reinforces the case for WEFE Nexus financing that builds systemic resilience across all three dimensions, rather than single-sector investments that may create new vulnerabilities downstream.

[18] Based on authors' analysis of latest reported data from Sub-Saharan African countries on https://unstats.un.org/sdgs/dataportal/database
[19] Ibid.

Gender Dimensions of WEFE Finance

The gender dimensions of WEFE insecurity in Sub-Saharan Africa are well-documented but systematically underfunded. Women constitute the majority of smallholder farmers across the region; they collect an estimated 70% of household water; and they bear the primary caregiving burdens, which intensify when water, energy, and food become scarce. [25] Yet access to, control over and benefits from WEFE nexus investments remain structurally skewed by gender. Women face greater barriers to land tenure, credit access and technology adoption, limiting their ability to benefit from solar irrigation, conservation agriculture or renewable energy mini-grids.

Data related to SDG indicator 7.1.2 on clean cooking illustrates the gendered dimension. With a regional average of only 27% clean fuel access, most women and girls across Sub-Saharan Africa continue to bear the health burden of indoor air pollution and the time cost of fuel gathering. Five countries are actively regressing on this indicator: Zambia (−4.8 percentage points), Equatorial Guinea (−2.1), Malawi (−0.7), Gambia, and Burundi.

Climate vulnerability exacerbates gender inequality across WEFE dimensions. Women and girls are more likely to be pulled out of education and employment to manage household resource deficits during droughts or floods, reinforcing intergenerational cycles of poverty. WEFE Nexus finance that does not explicitly design for gender equity will not address these structural dynamics and may inadvertently replicate or deepen existing inequalities. Gender-responsive WEFE finance requires: explicit gender targets in project design; participation of women as co-designers and decision-makers; ownership and benefit-sharing structures that recognize women's roles; and data collection disaggregated by gender to track outcomes. [25]

Youth as WEFE Entrepreneurs and Agents of Change

Sub-Saharan Africa has the youngest population globally, with 70% of the population under 30.[26] This demographic reality is simultaneously a development opportunity and a governance challenge. Climate strategies and finance must integrate youth not merely as beneficiaries but as entrepreneurs, innovators and decision-makers in the design and implementation of WEFE nexus solutions. Pay-as-you-go solar business models, IoT-based precision irrigation platforms, and green ammonia fertilizer production, all documented in the WEFE Table 4, are precisely the types of innovation ecosystems in which young African entrepreneurs can lead.

Yet youth-led enterprises face compounding barriers to WEFE finance: limited collateral for commercial credit; exclusion from formal banking systems; and minimal representation in the NDC planning processes that shape investment priorities. Dedicated WEFE entrepreneurship finance windows, including concessional startup capital, mentorship linkages with established firms, and market access guarantees, are needed to harness the continent's demographic dividend for sustainable resource management.

VI. Proven WEFE Nexus Technologies and Their Financing Models

Evidence from the field demonstrates that a growing portfolio of WEFE Nexus technologies is delivering measurable co-benefits across the water, energy, food, and ecosystem dimensions in

Sub-Saharan Africa. The following categories represent investment-ready solutions with documented proof of concept to be significantly scaled with appropriate financing instruments.

Decentralized Solar Energy Systems

Decentralized solar mini-grids are the most widely documented WEFE Nexus technology in the region. M-KOPA Solar has connected over 1.2 million off-grid homes in East Africa to pay-as-you-go solar energy systems, reducing reliance on kerosene and biomass while providing electricity for water pumping, food preservation and small business operations. The pay-as-you-go model demonstrates a commercially viable financing structure that is applicable at scale: customers pay incrementally via mobile money, eliminating the need for upfront capital while generating predictable revenue streams for the operator.

The RETO-DOSSO Solar Nexus Pilot in Niger, implemented by UNU-EHS, provides an important proof-of-concept for nexus integration: solar systems power groundwater pumps, support irrigation, and provide electricity for village businesses, demonstrating a sustainable business model for local investors. Scaling this model requires access to project preparation facilities, local currency financing and technical assistance for business model development.

Beyond pilot programs, massive regional scaling is currently underway through international climate finance and blended facilities. For example, the **ASER project in Senegal (FP138)**, supported by the Green Climate Fund (GCF) and the West African Development Bank (BOAD), is deploying off-grid solar to 1,000 isolated villages. Similarly, projects in **Mali (FP102)** and the **Democratic Republic of Congo (FP096)** are rolling out multi-megawatt solar mini-grids with storage. These deployments are increasingly supported by blended finance vehicles like **REPP 2**, a USD 250 million facility designed to build local developer capacity and provide sustainable energy access to 7.7 million people.

Solar-Powered Irrigation and Agrivoltaics

Solar-powered irrigation systems reduce dependency on diesel pumps, cutting greenhouse gas emissions by an estimated 50-70% per ton of food produced while reducing operational costs and improving water scheduling flexibility. The GGGI Solar Irrigation and Mini-Grid Project in Ethiopia combines solar irrigation pumping systems with mini-grid development, pilot installations, capacity building and ecosystem restoration, demonstrating an integrated WEFE approach within a single project framework.

Agrivoltaic systems, which integrate solar panels with agricultural production, represent a frontier technology for WEFE finance. Pilot projects in Niger demonstrate that the shade provided by solar panels reduces water evaporation, reducing irrigation requirements by 30-60% while generating electricity from the same land area. The APV-MaGa project in Mali and the Gambia, and the multi-country agrivoltaic pre-feasibility study supported by UNEP-CTCN across Congo-Kinshasa, Guinea, Senegal and Togo provide the evidentiary foundation for scaling this approach. Financing agrivoltaics requires instruments that can capture revenue from both agricultural and energy output streams, combining power purchase agreements with agricultural off-take contracts.

These integrated solutions are now attracting major institutional capital. The Safe Water Powered by Renewable Energy (FP243) project in Ethiopia, approved in 2024 with USD 50 million, represents the "state-of-the-art" in Nexus financing. It scales solar-powered pumping to

simultaneously provide safe drinking water and agricultural irrigation, entirely replacing costly and polluting diesel infrastructure. At an even larger scale, the World Bank's Transforming Irrigation project in Nigeria (P123112) is deploying USD 495.3 million to integrate solar capabilities with large-scale drainage and Integrated Water Resources Management (IWRM).

Solar-Powered Cold Chain and Post-Harvest Infrastructure

Post-harvest food loss in Sub-Saharan Africa is estimated at 20-40% of total production, representing both a food security failure and a significant financial loss for smallholder farmers. [9] The Africa Centre of Excellence for Sustainable Cooling and Cold Chain (ACES) in Rwanda demonstrates the WEFE finance potential of solar-powered cold chain infrastructure: reducing food loss increases effective food production per unit of water and energy input, while providing smallholder farmers with market access and income stability that improves their creditworthiness for subsequent investments. Financing models that link cold storage providers, agricultural cooperatives and renewable energy utilities through long-term off-take agreements represent a replicable WEFE Nexus investment structure.

Conservation Agriculture and Ecosystem-Based Approaches

Conservation agriculture practices — including minimum tillage, crop rotation and residue management — simultaneously reduce water requirements, increase soil carbon, and improve yields under climate stress. These ecosystem-based approaches are low-capital, high-impact investments that are particularly suited to smallholder financing instruments, including input loans, weather-indexed insurance and savings groups. Linking conservation agriculture adoption to results-based finance mechanisms or carbon markets provides an additional revenue stream that can offset transition costs and incentivize uptake at scale.

At the landscape level, these approaches are being integrated into massive catchment management and climate-resilient infrastructure projects. For instance, the **Mkondoa Catchment project in Tanzania** focuses on holistic watershed restoration across 1,200 hectares alongside early warning systems (EWS). Furthermore, data-driven adaptation is being scaled through Hydromet initiatives, such as the **Volta Basin Regional Project** and national programs in **Malawi (FP002)** and **Burkina Faso (FP074)**, which utilize climate forecasting and EWS to protect agricultural yields, manage cross-border water flows, and safeguard infrastructure.

Success stories

Documented success stories include conservation agriculture, deployment of renewable energy and implementation of integrated solutions such as solar-powered irrigation and agrivoltaics (agricultural solar farming). These technologies highlight the diverse and innovative efforts underway to address the interconnected challenges of water scarcity, energy access, and food security in Sub-Saharan Africa. They have been compiled with a focus on innovative or frontier technology solutions that have proven results on the ground today, to ensure scale-up potential.

The March 2025 Workshop on Accelerating the WEFE Nexus in Sub-Saharan Africa collected examples of technologies that can advance integrated progress across Water-

Energy-Food-Ecosystems in the region. These projects exemplify innovative approaches to addressing the WEFE Nexus. While they did not originally aim to ensure progress across the WEFE Nexus, as innovations, they have proven their ability to advance the WEFE nexus in Sub-Saharan Africa. These success cases have been compiled into the table below to provide a template for scaling up localized access to water-energy-food across the region (See Table 3).

Table 4. Success Cases of Water-Energy-Food Nexus Technologies in Sub-Saharan Africa

TECHNOLOGY	DESCRIPTION	COUNTRY/REGION	KEY PARTNERS
SOLAR-POWERED DRIP IRRIGATION (SOLAR MARKET GARDENS)	Developed by the Solar Electric Light Fund (SELF), this system uses solar energy to power water pumps for drip irrigation, enhancing food security and nutrition, especially during dry seasons.	Benin	SELF, ICRISAT, ADESCA
INNOVATION: AFRICA SOLAR WATER & ENERGY SYSTEMS	Israeli NGO Innovation: Africa installs solar-powered water pumps and energy systems in rural villages, providing clean water and electricity to schools and medical centers.	Multiple Sub-Saharan African countries	Innovation: Africa
RETO-DOSSO SOLAR NEXUS PILOT	A pilot project by UNU-EHS is installing solar systems to power groundwater pumps, support irrigation, and provide electricity for village businesses, aiming to demonstrate a sustainable business model for local investors.	Niger (Dosso Region)	UNU-EHS, PACET
WITSAND SOLAR DESALINATION PLANT	Africa's first solar-powered desalination plant, using reverse osmosis to produce up to 300,000 liters of potable water daily, addresses freshwater scarcity in coastal towns.	South Africa (Western Cape)	Mascara Renewable Water, TWS-Turnkey Water Solutions
BBOXX OFF-GRID SOLAR SYSTEMS	Provides pay-as-you-go solar energy solutions, including solar panels, batteries, and appliances, improving access to	Multiple African countries	Bboxx

	electricity for households and small businesses.		
AGROPHOTOVOLTAICS (APV-MAGA)	Integrates photovoltaic energy production with agriculture, enabling simultaneous land use for solar energy and crop cultivation and enhancing resilience against climate change.	Mali and The Gambia	APV-MaGa Project
SMART IOT FRAMEWORK FOR MAIZE FARMING	An IoT-based system providing real-time data for efficient irrigation and crop management, aiming to improve maize yields and resource use efficiency.	Uganda	Nomugisha Godwin, Dr. Mwebaze Johnson
GREEN AMMONIA FERTILIZER PRODUCTION (TALUSAG)	Develops local production of green ammonia fertilizers using renewable energy, reducing reliance on imports and lowering greenhouse gas emissions.	Sub-Saharan Africa (various countries)	TalusAg
SOLAR-POWERED COLD CHAIN INFRASTRUCTURE (ACES)	Establishes sustainable cold chain systems powered by solar energy to reduce post-harvest food loss and improve food security.	Rwanda	Africa Centre of Excellence for Sustainable Cooling and Cold Chain (ACES)
MONEYMAKER PLUS IRRIGATION PUMP	A manual irrigation pump enabling smallholder farmers to irrigate their fields efficiently, increasing crop yields and incomes.	Kenya	Approtec (now KickStart International)
GGGI SOLAR IRRIGATION & MINI-GRID PROJECT	The Global Green Growth Institute (GGGI) is implementing a project in Ethiopia to promote solar irrigation pumping systems and mini-grids, aiming to enhance climate-smart agriculture. The initiative includes pilot installations, capacity building, and ecosystem restoration efforts.	Ethiopia	GGGI/Ministry of Foreign Affairs of Denmark
O2&B SOLAR IRRIGATION INITIATIVE	O_2NB is deploying solar-powered irrigation systems designed for smallholder	Tanzania, Ethiopia, and others	KIST

	farmers in drought-prone regions. The systems, equipped with IoT technology, offer efficient water usage and energy access, contributing to improved agricultural productivity and resilience.		
EMPOWERING COMMUNITIES OF KADUNA STATE, NORTH-WEST NIGERIA WITH SUSTAINABLE AGRICULTURAL PRACTICES (EM-HYDRO) UNDER EC CLIMATE CHANGE AND SECURITY PROGRAMME	Piloting a small-scale solar-powered hydroponics system as a strategic solution aimed at addressing the interrelated challenges of climate change, insecurity, and food security in the region.	Nigeria	UNEP-CTCN, EU
MULTI-COUNTRY AGRIVOLTAIC TECHNOLOGY PROJECT IN WEST AND CENTRAL AFRICA	The multi-country agrivoltaic project aims to conduct a pre-feasibility study to evaluate the potential use of agrivoltaic technology in the requesting countries.	Congo – Kinshasa, Guinea, Senegal, Togo	UNEP-CTCN, EU

VII. Policy Recommendations

The evidence base examined in this brief points to five interconnected recommendations for advancing WEFE Nexus financing in Sub-Saharan Africa. These recommendations are directed at national governments, regional institutions, multilateral development banks, bilateral donors and private sector actors.

RECOMMENDATION 1: Embed WEFE Integration in NDC 3.0 Frameworks

National governments preparing NDC 3.0 submissions should explicitly adopt WEFE Nexus planning frameworks, establishing integrated targets for water-energy-food-ecosystems investments, cross-ministerial accountability structures and costed financing plans that bridge the gap between climate commitments and national development plans.

Specifically, NDCs should:

- Include specific WEFE Nexus investment targets with quantified co-benefits (e.g., hectares of solar irrigation, MW of mini-grid capacity linked to agricultural productivity)
- Establish cross-sector budget alignment between water, energy, agriculture and environment ministries in medium-term expenditure frameworks
- Develop National WEFE Nexus Investment Plans as annexes to NDCs, translating climate commitments into bankable project pipelines
- Engage NDC Partnership support for WEFE-integrated NDC design and financing strategy development

- Integrate SDG tracking benchmarks. NDC 3.0 submissions should include SDG 6 and SDG 7 indicator benchmarks, to align with adopted monitoring targets.

RECOMMENDATION 2: Establish a Regional WEFE Nexus Finance Facility

Multilateral development banks, bilateral donors and African Union institutions should establish a dedicated regional WEFE Nexus Finance Facility, combining:

- A project preparation facility providing grants and technical assistance to develop investment-grade WEFE project pipelines
- A blended finance vehicle combining first-loss concessional capital from multilateral climate funds with mezzanine DFI financing and senior commercial debt
- A results-based disbursement window rewarding verified WEFE co-benefits across water, energy, food and ecosystem dimensions
- A WEFE technology clearinghouse documenting proven solutions, financing models and replication pathways

Institutions like the African Development Bank, in coordination with the Green Climate Fund and bilateral climate finance institutions, is best positioned to anchor such a facility, building on existing programmes including the Africa Water Investment Programme (AIP) and the Continental Power Systems Master Plan.

RECOMMENDATION 3: Develop Integrated WEFE Valuation Methodologies

Development finance institutions, research organizations and standards bodies should collaborate to develop standardized multi-sector valuation methodologies for WEFE Nexus projects. These methodologies should:

- Quantify co-benefits across water, energy, food and ecosystem dimensions in financial terms, enabling comparison with single-sector investment alternatives
- Incorporate social co-benefits, including gender empowerment, youth employment and poverty reduction in project appraisal
- Provide the evidentiary basis for green bond taxonomies, sustainability-linked finance instruments and results-based disbursement triggers
- Align with existing SDG monitoring frameworks and NDC tracking systems to avoid parallel reporting burdens
- Invest in data as a precondition. There are critical data gaps for SDGs. Without reliable cross-sector data, investors cannot verify the co-benefits that justify nexus investment premiums.

The Frontiers WEFE Finance framework (2025), UNESCO WEFE Nexus implementation guidance, and GIZ nexus trade-off analysis tools provide building blocks for this methodological development. [6]

RECOMMENDATION 4: Mainstream Gender and Youth in WEFE Finance Design

All WEFE Nexus financing instruments should adopt mandatory gender-responsive and youth-inclusive design standards:

- Gender-disaggregated targets for access, ownership and benefit-sharing from WEFE investments
- Dedicated financing windows for women-led and youth-led WEFE enterprises, including concessional startup capital and mentorship linkages
- Participatory project design processes that meaningfully involve women and youth as co-designers, not merely consulting stakeholders
- Integration of gender and youth outcomes into results-based finance disbursement triggers

Bilateral donors and multilateral climate funds should condition WEFE Nexus finance tranches on demonstrated gender equity and youth inclusion targets.

RECOMMENDATION 5: Mobilize Domestic Capital and Strengthen Financial Architecture

Reducing sub-Saharan Africa's dependence on external WEFE finance requires systematic mobilization of approximately USD 2.4 trillion in domestic bank, insurance and pension assets, alongside institutional reforms that improve the investment environment for climate-aligned WEFE projects:

- National WEFE green finance taxonomies aligned with international standards, enabling domestic institutional investors to classify and report on WEFE-aligned holdings
- Pension fund regulatory reforms permitting investment in infrastructure and project finance vehicles for WEFE nexus projects
- Domestic green bond markets with standardized WEFE project eligibility criteria
- Local currency financing instruments that reduce exchange rate risk for WEFE project developers and operators
- Target investment in countries with least renewable energy generating capacity(e.g. Chad, Gambia) to advance progress alongside water and food security goals.
- Strengthened public financial management and procurement frameworks to reduce transaction costs and improve the attractiveness of WEFE public-private partnerships

The African Union's Continental Africa Water Investment Programme (AIP), launched at the 2023 Water Conference and COP28 with a goal of mobilizing at least USD 30 billion and creating over 5 million jobs by 2030, [10] provides a continental platform for coordinating these domestic mobilization efforts – but needs to align with the regional energy plans. The Continental Master Plan for Electricity in Africa (CMP) aligns regional and national energy initiatives with the African Union's Agenda 2063 vision of a single electricity market (AfSEM) but this Master Plan does not include assessment of links with water and food security, nor ecosystems.

VIII. Conclusion

Financing the WEFE Nexus in Sub-Saharan Africa is not merely a technical challenge of mobilizing additional capital; it is a governance imperative that requires a fundamental shift in how climate finance is designed, valued, targeted, and deployed. Siloed finance for water, energy and food investments forfeits multiplier development gains; the most climate-vulnerable nations receive the least finance; and current flows meet only 23% of the region's NDC investment needs.[4]

A portfolio of proven WEFE technologies — from solar-powered irrigation to agrivoltaics, solar cold chain infrastructure to conservation agriculture — is ready for scaling with appropriate financing instruments. Blended finance, green bonds, payment for ecosystem services, and well-designed public-private partnerships can collectively bridge the investment gap, provided they are structured to capture and reward integrated WEFE co-benefits rather than single-sector returns.

If countries embed WEFE Nexus frameworks in their NDC 3.0 commitments, establish cross-ministerial accountability structures, and develop investable WEFE project pipelines, they will create the institutional conditions for climate finance to deliver the multiplier effects that the 2030 Agenda and Paris Agreement demand. The most climate-vulnerable nations continue to receive the least finance, but there is an opportunity to realize efficiencies and optimize limited resources to deliver gains across the Sustainable Development Goals if action is taken today.

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Note: Endnote reference numbers correspond to in-text superscript citations throughout the brief.

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About this Policy Brief

This policy brief is the second in a series of publications by the United Nations Office for Sustainable Development (UNOSD) under the Division for SDGs of the UN Department of Economic and Social Affiairs (UNDESA) with the United Nations University Institute for Water, Environment and Health (UNU-INWEH) with the UNEP Climate Technology Centre and Network (CTCN) on Accelerating the Water-Energy-Food-Ecosystems (WEFE) Nexus in Sub-Saharan Africa as part of the OIBC 4 (Opportunities and Issues-Based Coalition) on Fostering Climate Action, Resilience, and Food Systems. It draws on a systematic review of academic and grey literature, analysis of Nationally Determined Contributions from 48 sub-Saharan African countries, and evidence compiled from the March 2025 UNOSD Workshop on Accelerating the WEFE Nexus in Sub-Saharan Africa. The brief is developed in support of the 2030 Agenda for Sustainable Development, the AU Agenda 2063, and the Paris Agreement. An additional brief focused on governance can also be found here https://unu.edu/inweh/collection/accelerating-progress-water-energy-food-ecosystem-wefe-nexus-sub-saharan-africa

Annex 1

Mapping of climate finance commitments and progress in linking WEFE with NDCs in regional countries

Overall, there is a growing recognition of the interlinkages between water, energy, and food security in the region's climate strategies. This can be measured by assessing the integration of key technologies or their mentions in the existing Nationally Determined Contributions from countries in the region, as many countries did not yet submit updated NDCs (NDC 3.0) at the time of analysis (March 2025).

The table below illustrates the varying degrees to which Sub-Saharan African countries incorporate the WEF nexus into their previously submitted NDCs. The table highlights the degree of integration and specific measures related to water, energy, and food security within each country's climate commitments. Results show that countries like Ethiopia and Sudan are highly integrated with specific targets and projects, while others are at the early stages of incorporating WEF considerations.

Table 1. Water-Energy-Food Nexus Integration in Sub-Saharan African Nationally Determined Commitments (NDCs)

Country	WEF Nexus Integration in NDC	Specific Measures	Context
Angola	**Moderate**	Promotion of renewable energy sources; improvement of water infrastructure for agriculture	Focus on diversifying the energy mix and enhancing irrigation systems.
Benin	**Moderate**	Development of solar energy projects; initiatives to improve water access for farming communities	Emphasis on rural electrification and agricultural resilience.
Botswana	**Emerging**	Plans to expand renewable energy capacity; strategies to improve water management for agriculture	Initial steps towards integrated resource planning.
Burkina Faso	**High**	Implementation of solar irrigation systems; investment in water harvesting techniques	Strong focus on sustainable agriculture and energy access.
Burundi	**Moderate**	Development of hydropower projects; improvement of agricultural water use efficiency	Emphasis on renewable energy and sustainable farming practices.
Cameroon	**Moderate**	Expansion of hydroelectric power; enhancement of irrigation infrastructure	Integration of energy and water strategies to support agriculture.

Cape Verde	**High**	Investment in desalination powered by renewable energy; promotion of sustainable agriculture	Comprehensive approach to address water scarcity and food security.
Central African Republic	**Emerging**	Plans to develop renewable energy sources; initiatives to improve water access	Early stages of integrating WEF considerations.
Chad	**Moderate**	Development of solar energy projects; improvement of water infrastructure for agriculture	Focus on enhancing resilience in arid regions.
Comoros	**High**	Implementation of renewable energy projects; investment in water conservation for agriculture	Strong commitment to sustainable resource management.
Congo (Brazzaville)	**Moderate**	Expansion of hydroelectric power; improvement of agricultural practices	Emphasis on energy development and food security.
Congo (Kinshasa)	**Moderate**	Development of renewable energy projects; enhancement of water infrastructure	Focus on rural development and access to resources.
Côte d'Ivoire	**High**	Investment in renewable energy; promotion of sustainable agriculture practices	Comprehensive strategies for integrated resource management.
Djibouti	**High**	Development of solar and wind energy projects; improvement of water access for agriculture	Strong focus on renewable energy and water security.
Equatorial Guinea	**Emerging**	Plans to diversify energy sources; initiatives to improve water and food security	Initial steps towards WEF integration.
Eritrea	**Moderate**	Development of renewable energy projects; enhancement of water infrastructure for agriculture	Emphasis on sustainable development in arid regions.
Eswatini	**Moderate**	Expansion of renewable energy capacity; improvement of irrigation systems	Focus on energy access and agricultural productivity.
Ethiopia	**High**	Construction of dams to increase water storage and improve national access to energy; enhancement of irrigation systems to reduce water loss	Aims to improve water availability for agriculture and resilience to droughts.
Gabon	**Moderate**	Development of hydropower projects; promotion of sustainable agriculture	Integration of energy and food strategies.

Gambia	**High**	Implementation of solar irrigation systems; investment in water conservation techniques	Strong focus on sustainable agriculture and energy access.
Ghana	**High**	Expansion of renewable energy projects; improvement of water infrastructure for agriculture	Comprehensive approach to WEF integration.
Guinea	**Moderate**	Development of hydropower projects; enhancement of irrigation systems	Focus on energy development and agricultural resilience.
Guinea-Bissau	**Emerging**	Plans to develop renewable energy sources; initiatives to improve water access	Early stages of integrating WEF considerations.
Kenya	**Moderate**	Target to provide access to safe and clean water to at least half of the population by 2030	Emphasizes water access as a climate adaptation measure.
Lesotho	**Emerging**	Development of funding concept notes for climate resilience projects addressing land degradation and agriculture	Engages in planning for integrated resource management.
Liberia	**Moderate**	Expansion of renewable energy capacity; improvement of water infrastructure for agriculture	Focus on enhancing resilience and access to resources.
Madagascar	**Moderate**	Development of renewable energy projects; promotion of sustainable agriculture practices	Emphasis on integrated resource management.
Malawi	**Emerging**	Implementation of solar-powered irrigation systems as part of the GCCA+ project	Demonstrates integrated WEF projects at the community level.
Mali	**High**	Investment in renewable energy; enhancement of water infrastructure for agriculture	Strong commitment to sustainable development.
Mauritania	**Moderate**	Development of solar and wind energy projects; improvement of water access for agriculture	Focus on resource management in arid regions.
Mauritius	**High**	Investment in renewable energy; promotion of sustainable agriculture practices	Comprehensive strategies for integrated resource management.
Mozambique	**High**	Expansion of renewable energy projects; improvement of water infrastructure for agriculture	Emphasis on sustainable development and resilience.

Namibia	**Moderate**	Development of solar energy projects; enhancement of water infrastructure for agriculture	Focus on resource management in arid regions.
Niger	**High**	Implementation of solar irrigation systems; investment in water conservation techniques	Strong focus on sustainable agriculture and energy access.
Nigeria	**High**	Expansion of renewable energy projects; improvement of water infrastructure for agriculture	Comprehensive approach to WEF integration.
Rwanda	**High**	Expansion of hydro and solar mini-grids; plans to connect 52% of households to the grid and 48% to off-grid electricity	Integrates energy access with rural development and agriculture.
São Tomé and Príncipe	**Moderate**	Development of renewable energy projects; improvement of water access for agriculture	Focus on sustainable development and resilience.
Senegal	**High**	Investment in renewable energy; promotion of sustainable agriculture practices	Comprehensive strategies for integrated resource management.
Seychelles	**High**	Development of renewable energy projects; enhancement of water infrastructure for agriculture	Strong commitment to sustainable development.
Sierra Leone	**Moderate**	Expansion of renewable energy capacity; improvement of water infrastructure for agriculture	Focus on enhancing resilience and access to resources.
Somalia	**Emerging**	Plans to develop renewable energy sources; initiatives to improve water and food security	Initial steps towards WEF integration.
South Africa	**High**	Investment in renewable energy; promotion of sustainable agriculture practices	Comprehensive approach to WEF integration.
South Sudan	**High**	Development of hydro at the Fulla Rapids and solar and wind projects	Focus on renewable energy development.
Sudan	**High**	Increase use of renewable energy in the water sector; target to reduce GHG emissions from the sector by 20%	Focuses on integrating renewable energy into water management.
Tanzania	**Moderate**	Promotion of renewable sources such as geothermal, wind, solar, and renewable biomass; plans for 3.3 GW of renewables by 2030	Addresses energy needs with implications for agriculture and water use.

Togo	**Moderate**	Development of hybrid mini-grids; improvement of water infrastructure for agriculture	Focus on sustainable development and resilience.
Uganda	**Moderate**	Plans for 2,471 MW of renewable energy by 2030, including hydro, solar, biomass, and geothermal	Focuses on expanding renewable energy capacity.
Zambia	**Moderate**	Biomass electricity generation; off-grid mini-hydro, solar, and wind; biofuels and biodigesters	Aims to diversify energy sources with potential benefits for agriculture.
Zimbabwe	**Moderate**	27 MW of mini-hydro; 1,250 biodigesters; investment in solar water heaters	Targets renewable energy expansion with applications in agriculture and water heating.