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Putting research knowledge into action

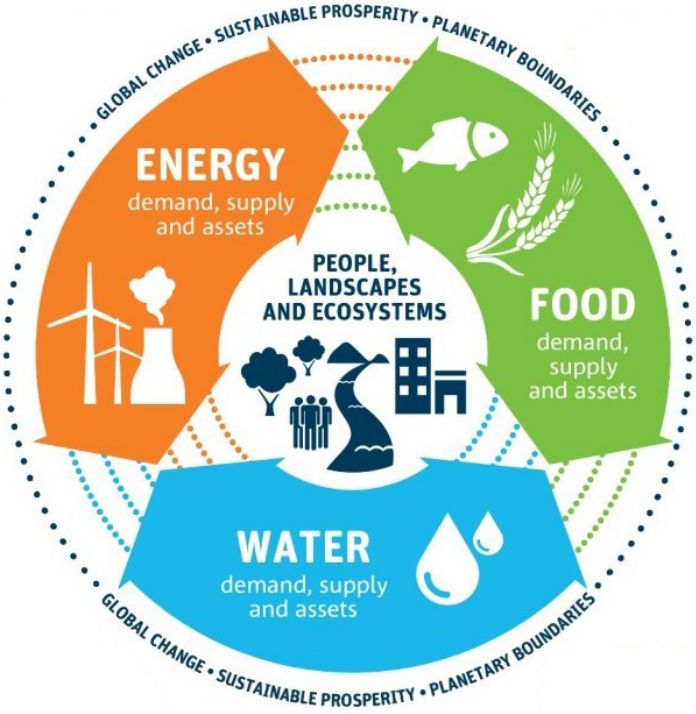
The Water-Energy-Food-Ecosystem Nexus approach to water infrastructure in Africa: Integrated planning, climate resilience, and inclusive growth

Key messages

- **Africa is at a tipping point.**
  Intersecting crises of water scarcity, food insecurity, energy poverty, and ecosystem degradation threaten development and climate resilience. Vulnerable countries risk gross domestic product losses of 5–7% per year.
- **'Business as usual' is not enough.**
  Siloed, sector-by-sector approaches to infrastructure are both inefficient and unsustainable. Integrated planning is urgently needed to unlock co-benefits and reduce conflict.
- **The WEFE Nexus offers a transformative pathway.**
  The Water–Energy–Food–Ecosystem (WEFE) Nexus enables smarter investments that enhance resilience, balance trade-offs, and align with Africa's Agenda 2063 and the Sustainable Development Goals (SDGs).
- **Evidence from across Africa proves the case.**
  Case studies in Niger, Kenya, Senegal, Ethiopia, South Africa, and Zambia demonstrate measurable gains, including:
  - Returns on investment rising by 20–35%
  - Climate resilience increasing by 40–45%
  - A 2.5-fold expansion in opportunities for women and youth
- **Risks can be turned into opportunities.**
  Green-grey infrastructure, early warning systems, and circular economy models mitigate climate and disaster risks, create jobs, empower women, and strengthen food and energy security.
- **Institutional and financial innovation is key.**
  Scaling requires permanent Nexus coordination units, robust data systems, and blended financing, such as climate funds, green bonds, and Public Private Partnerships (PPPs) to support multipurpose, cross-sectoral infrastructure.
- **Inclusive governance drives success.**
  Community-led design, gender-responsive planning, and participatory monitoring ensure that WEFE investments deliver equitable benefits and long-term sustainability.

Introduction

Africa's sustainable development is increasingly challenged by the interconnected pressures of water scarcity, energy poverty, food insecurity, and ecosystem degradation, all of which are exacerbated by climate change (Herrera-Franco et al. 2023). Water is central to this crisis, acting as a vital connector across food, energy, economic, and environmental systems (Figure 1). With over 40% of the continent's population facing water stress (UNECA 2022) and climate-related disasters costing an estimated 5–7% of the annual Gross Domestic Product in vulnerable nations (AfDB 2023), traditional sectoral approaches to infrastructure development are no longer sufficient.



Water-Energy-Food Nexus (*Source*: Crimp and Lim-Camacho [2017])

The Water-Energy-Food-Ecosystem (WEFE) Nexus offers a more integrated framework managing natural resources and addressing these systemic challenges (Hoff 2011). In Africa, the Nexus approach aligns with continental policy frameworks, including the African Union's Continental Water Policy and Agenda 2063, which prioritizes climate-resilient infrastructure and transboundary cooperation (AU 2022). The CGIAR Nexus Gains Initiative has further advanced practical applications, demonstrating how Nexus solutions can simultaneously improve nutrition, reduce poverty, enhance gender equity, build climate resilience, and restore ecosystems (CGIAR Initiative on NEXUS Gains 2025).

This paper examines how the WEFE Nexus approach, when applied to water infrastructure development in Africa, can enhance climate resilience, disaster risk reduction, and inclusive economic growth while contributing to the CGIAR impact areas (ILRI n.d.). It focuses on three critical dimensions:

(i) integrated planning for multi-sector benefits – how can water infrastructure be designed to serve energy, agriculture, and ecosystems simultaneously?
(ii) enhancing climate resilience and disaster preparedness – what role can green-grey hybrid systems play in mitigating floods and droughts?
(iii) catalyzing inclusive economic growth – how can the Nexus approach create jobs and empower marginalized groups?

The paper contributes to ongoing policy dialogue on sustainable infrastructure development in Africa by offering empirical insights from real-world Nexus implementations, identifying scalable governance and financing models, and offering actionable recommendations for policymakers. The findings are timely as African nations seek to operationalize the Global Goal on Adaptation agreed at the 28th Conference of the Parties (COP28) and advance Sustainable Development Goal 6 (Clean Water and Sanitation) while addressing energy and food security challenges (UNFCCC 2023).

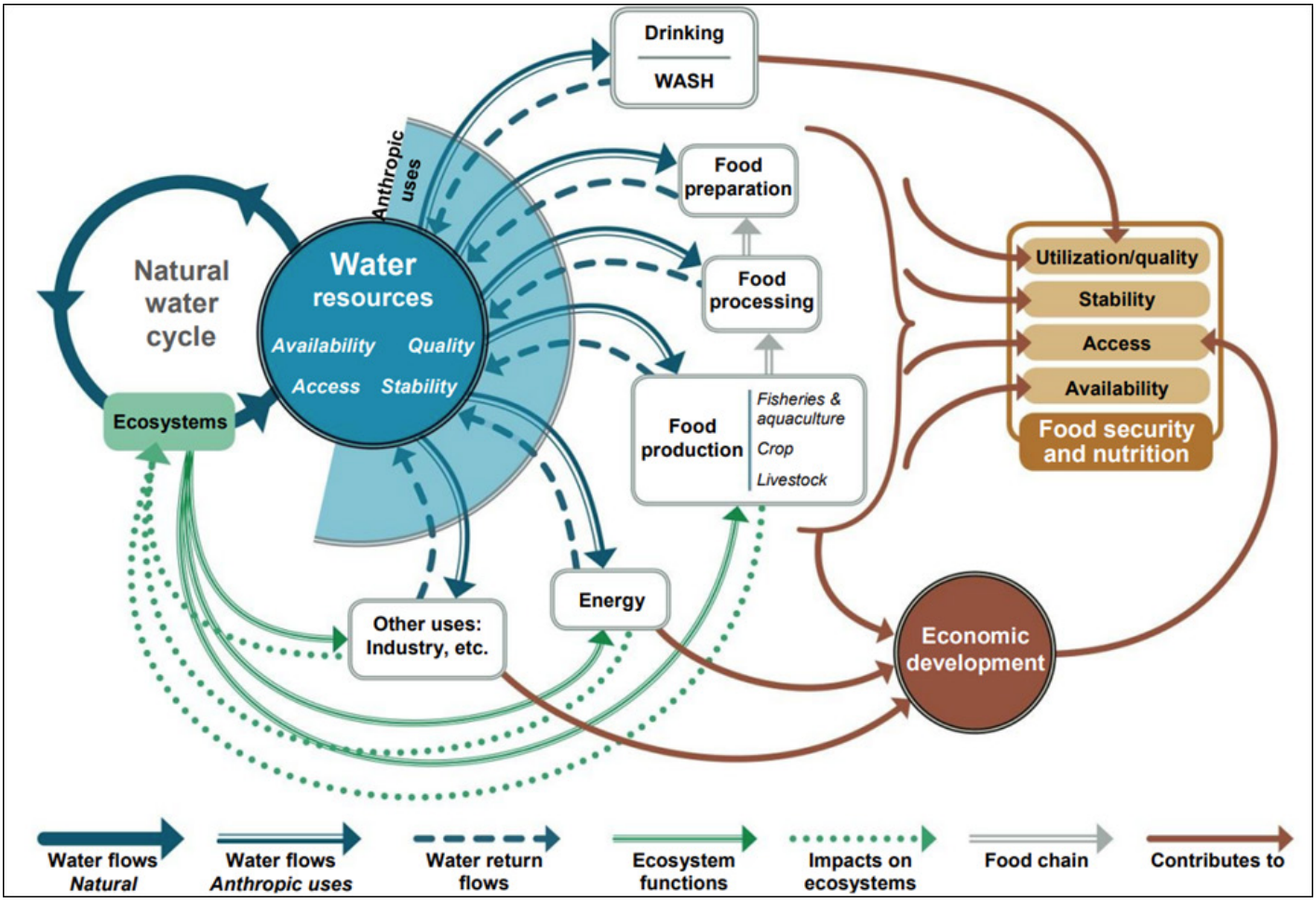


Figure 1. Multiple interfaces between water and food security and nutrition.
Source: HLPE (2015)
Note: WASH - Water, sanitation, and hygiene.

Intersecting water crises: A paradigm shift

Africa's water crisis is complex and deeply interconnected with energy, food, and environmental systems. It is driven by uneven water distribution, growing demand, and aging or deteriorating infrastructure. Currently, an estimated 400 million people lack access to clean water and 700 million live without adequate sanitation (UNICEF and WHO 2023). In most regions, water scarcity affects one in every three people, and more than 20% of the sub-Saharan African (SSA) population is food insecure (Affoh et al. 2022).

A significant portion of SSA's water infrastructure is old and suffers from post-construction degradation, resulting in considerable system losses that undermine energy generation and agricultural productivity. These failures are commonly linked to changing hydro-climatic conditions, inadequate maintenance, and unclear land tenure arrangements.

Evaluations of irrigation infrastructure developments reveal systemic challenges. Many schemes have failed to deliver their design objectives largely due to underinvestment in good planning, design, and project administration (Higginbottom et al. 2021). Small-scale systems are particularly vulnerable, often lacking institutional support and financing. Moreover, there has been a limited effort to promote co-investments across sectors, integrate surface water and groundwater use, deploy decision-support systems for inter-sectoral water allocations, and alternate renewable energy supplies (Liersch et al. 2023).

Climate change further compounds Africa's water challenges, with the increasing frequency of droughts and floods disrupting agriculture and energy generation (IPCC 2022) and the livelihoods of millions. For instance, the 2021–2023 Horn of Africa drought—the region's worst in 40 years—left 23 million people food insecure and resulted in an estimated USD 7 billion in economic losses (FAO 2023). Simultaneously, rapid urbanization and population growth place additional stress on already overburdened water and energy systems (AU 2022).

Energy insecurity further compounds the crisis. Over 600 million Africans lack access to electricity (IEA 2024). Hydropower—which accounts for approximately 63% of global renewable energy production and is considered more affordable and cleaner (IRENA 2022)—is increasingly vulnerable to climate-induced rainfall variability (World Bank 2023) and soil degradation, with siltation reducing the capacity of many African dams.

In most African regions, food systems remain vulnerable, with 282 million people undernourished (FAO 2023), and agricultural productivity growth lagging behind the rapid population increases. Unsustainable water use and pollution are degrading freshwater resources, rendering many sources unsuitable for consumption or use (du Plessis 2019). The expansion and intensification of agriculture in most SSA countries has resulted in soil exhaustion, constraining both food production and essential ecosystem services (Tully et al. 2015).

The continent is also facing a biodiversity crisis with vertebrate populations declining by 65% since 1970 (Biggs et al. 2008) and one in four freshwater fish species threatened with extinction (WWF 2025). Soil degradation affects approximately 65% of productive lands (Vlek et al. 2017). These twin crises of ecological degradation and resource insecurity are exacerbated by climate change and unsustainable land-use practices (Brink et al. 2014; Niang et al. 2014), threatening long-term food security and ecosystem health across the continent.

Given the scale and interlinkages of these crises, incremental, siloed interventions are no longer viable. What is needed is a paradigm shift to integrated cross-sectoral planning and governance that acknowledges the interdependence between water, energy, food, and ecosystems (Bizikova et al. 2013).

The WEFE Nexus (Figure 2) offers a promising framework for resource management by enabling more coordinated and efficient efforts. It seeks to maximize synergies and minimize trade-offs across sectors (Hoff 2011), replacing fragmented decision-making with more holistic approaches. Key principles of the Nexus approach include:

i) integrated planning to prevent conflicts between sectoral priorities (e.g., hydropower vs. irrigation and ecosystem needs),
ii) multipurpose infrastructure, such as dams, that support energy, agriculture, and flood control,
iii) green-grey hybrid systems combining nature-based systems (e.g., wetlands) with engineered infrastructure (e.g., levees), and
iv) stakeholder coordination across governments, the private sector, and communities.

Thus, the WEFE Nexus contributes to a pathway for Africa to build resilient, equitable, and climate-smart water infrastructure that supports long-term sustainable development.

Figure 2. Water-Energy-Food-Environment (WEFE) Nexus: A critical challenge for sustainability.
Source: Aryal (2022)
Notes: MSP – Multi-sectoral program ; DSS - Decision support system.

Integrated planning for multi-sector benefits in Africa

Africa's development is severely hindered by siloed planning and fragmented governance of water, energy, and food systems. Integrated planning under the Water-Energy-Food-Ecosystems (WEFE) Nexus offers a transformative approach to overcome these inefficiencies, unlock multi-sector synergies, and deliver inclusive, climate-resilient outcomes. Drawing on diverse African case studies, this section examines how integrated WEFE Nexus planning can improve productivity, resilience, and social equity.

Breaking silos: Water-energy-food synergies

The transboundary nexus governance in the Niger River Basin: The Niger Basin Authority (NBA) provides a compelling example of transboundary WEFE planning through multi-sectoral management of the Kandaji Dam project (Nexus Resource Platform 2022). By coordinating hydropower generation (250 MW), irrigation for 185,000 hectares, and ecosystem conservation, the NBA has achieved:

i) a 30% increase in rice production without compromising fisheries (ILRI n.d.),
ii) 20% higher economic returns compared to single-sector projects,
iii) conflict reduction among riparian states through data-sharing platforms.

The NBA's Decision Support System played a key role in this success, as it models water allocation trade-offs (e.g., hydropower vs. irrigation) under various climate scenarios (Nexus Resource Platform 2022).

Hybrid green-grey systems: In Kenya, the integration of 12,000 hectares of strategic reforestation in upstream catchment areas with engineered dams has enhanced water regulation in the Tana River Basin, resulting in:

i) a 40% reduction in drought vulnerability and
ii) a 35% decrease in flood damage costs (TNC 2022).

Similarly, in the Upper White Nile Basin, Nexus-aligned planning has optimized ecosystem services around major lakes, highlighting the importance of water provision, artisanal fisheries, and biodiversity across all sectors (Schlemm et al. 2025).

Senegal's wastewater reuse program and Ethiopia's solar agriculture hubs: In urban Senegal, a treated wastewater irrigation project created 5,200 new jobs in market gardening, with 80% participation by women, resulting in a 30% increase in household incomes (AU 2022). In rural Ethiopia, decentralized solar hubs provide clean energy for 40,000 people while supporting irrigation and agro-processing for 8,000 smallholder farms, demonstrating the rural development multiplier effects of integrated solutions.

The Mining-Agriculture Nexus in South Africa's Olifants River: Historically polluted by acid mine drainage (AMD) from coal mining, which threatened 1.2 million smallholder farmers (Musvoto and De Lange 2019), the Olifants River has been transformed through a Nexus approach that includes:

(i) wetland-based AMD treatment, saving 5.6 million m³/year of freshwater and reducing heavy metal contamination that is toxic to plants and soil microbes,
(ii) reuse of treated water to irrigate 12,000 hectares of crops, and
(iii) the creation of 800 new jobs in water treatment and agro-processing.

This case highlights how Nexus planning can transform environmental liabilities into productive assets, balancing industrial and agricultural needs.

Zambia's WEFE Coordination Unit: With support from the Southern African Development Community (SADC) and regional Nexus dialogues, Zambia established Africa's first National Nexus Task Force in 2021, yielding notable outcomes such as:

(i) 65% faster project approvals through harmonized permitting across water, energy, and agriculture sectors (Simpson et al. 2023),
(ii) blended financing mobilizing USD 120 million from climate and infrastructure funds, and
(iii) community engagement, including the formal inclusion of Local Chiefs in basin planning committees.

Critical enablers of success included:

i) The creation of a national task force mandated with a unified oversight across water, energy, and agricultural ministries.
ii) Harmonized approval systems for water, energy, and agriculture.
iii) High-level political will to ensure compliance and the smooth functioning of Zambia's Coordination Unit and National Nexus Task Force.
iv) Decentralized authority with integrated planning mandates that enabled solutions to be tailored to local contexts.
v) Participatory monitoring and the creation of a centralized database.

Integrated WEFE Nexus planning in Africa has demonstrated measurable benefits, including increased agricultural productivity and reduced conflict (Table 1). The CGIAR Initiative on Nexus Gains revealed consistent patterns across these diverse implementations (Musvoto and De Lange 2019; Nexus Resource Platform 2022; Simpson et al. 2023) as follows:

- Economic benefits: 20–35% higher returns on investment compared to conventional projects.
- Climate resilience: 40–45% improvement in drought and flood preparedness.
- Social inclusion: a 2.5-fold increase in employment opportunities for women and youth.
- Environmental gains: 25% improvement in water quality indicators.

However, scaling these benefits requires overcoming key challenges through:

(i) institutional reforms to establish permanent Nexus coordination bodies,
(ii) data infrastructure for cross-sectoral monitoring, and
(iii) community-led design to ensure equity and sustainability.

Table 1. Comparative analysis of nexus governance models.

Country	Mechanism	Key Achievement	Challenge
Niger Basin	Transboundary Niger Basin Authority	30% higher crop yields	Upstream-downstream disputes
Zambia	National Task Force	65% faster project approvals	Limited local technical capacity
South Africa	Public-private partnerships	5.6M m³/year wastewater reuse	High treatment costs

Source: Data from Nexus Resource Platform (2022), Simpson et al. (2023), and Musvoto and De Lange (2019).

Africa's water infrastructure planning is at a turning point. These case studies demonstrate that integrated WEFE approaches are not just theoretical frameworks but practical pathways to inclusive development, improved resilience, and long-term sustainability. The next section explores how these principles can be embedded in climate resilience strategies, focusing on green-grey infrastructure innovations.

Agility and partnerships to minimize trade-offs and maximize synergies within the WEFE Nexus

The Water–Energy–Food–Ecosystems (WEFE) Nexus approach is not simply about aligning sectoral plans—it is about managing competing demands in real time while building coalitions to negotiate shared solutions. Traditional sector-by-sector planning often overlooks trade-offs, resulting in unintended consequences and often creating conflicts that leave many stakeholders—especially smallholders and marginalized groups—without a voice. Nexus approaches anticipate these tensions, embed negotiation processes, and adapt policies to minimize trade-offs and maximize synergies. Following are key examples from Zambia's experience that offer valuable insights:

Water allocation: Commercial irrigators vs. Small-scale irrigators vs. Grazing areas and hydropower

- Trade-off: Large-scale irrigation by the Zambia Sugar Company (ZAMSC) reduces grazing land for the Zambia Beef Company (ZAMBEEF), lowers river flows for small-scale irrigators, and decreases water availability for hydropower generation. Conversely, prioritizing hydropower storage in reservoirs limits dry-season irrigation.
- Conflict: Tensions between sugarcane farms (e.g., Nakambala Sugar) and the Kafue Gorge Dam's energy requirements.
- Nexus solution: A decision support tool that guides irrigation water abstraction without significantly affecting total or firm energy production. Dynamic water-release policies negotiated between the energy utility stakeholders and farmers.

Land use: Agriculture vs. Ecosystems

- Trade-off: Expanding cropland boosts food security but degrades wetlands such as the Lukanga Swamps, reducing flood buffering and biodiversity.
- Nexus approach: Incorporating environmental flow requirements into water permits, protecting critical ecosystems while maintaining agricultural production.

Energy priorities: Grid power vs. Rural access

- Trade-off: National grids prioritize urban and industrial demand, leaving smallholders reliant on diesel pumps or off-grid solar systems.
- Conflict: Mini-grids powered by solar initially faced resistance from the national utility, which was concerned about potential revenue losses affecting hydropower operations.
- Nexus solution: Blended finance models which now incentivize hybrid hydro-solar projects, extending clean energy access without undermining grid stability.

Economic vs. Social equity

- Trade-off: Large agribusinesses and energy projects often displace smallholder farmers and artisanal fishers, as observed in the expansion of commercial irrigation around Lake Kariba.
- Conflict: Traditional leaders (Chiefs) often mediate land disputes but face political and investor pressure.
- Nexus solution: Revenue-sharing models and outgrower schemes that integrate smallholders into commercial supply chains (e.g., sugar), ensuring local benefits.

Short-term gains vs. Long-term resilience

- Trade-off: Over-extraction of groundwater for irrigation boosts short-term yields but threatens aquifer depletion, as seen in Lusaka's water crisis.
- Nexus mitigation: Groundwater licensing, which is now linked to scientific recharge assessments, aligning agricultural expansion with long-term water availability.

The Zambian case shows that conflict is not a sign of Nexus failure; rather, it reflects that sectors are actively engaging over shared resources. Policy frameworks should view such tensions as opportunities for structured negotiation, where targeted tools, reliable data, and cross-sectoral institutions enable agreements that advance equity, optimize resource use, and strengthen climate resilience.

Enhancing climate resilience and disaster preparedness

The WEFE Nexus provides a critical framework for enhancing climate resilience and disaster preparedness by addressing the interconnected challenges of resource scarcity, extreme weather events, and ecosystem degradation. Across Africa—where climate change is exacerbating droughts, floods, and food insecurity—integrated green-grey infrastructure and early warning systems have emerged as transformative solutions. These approaches not only mitigate disaster risks but also safeguard water, energy, and food security while preserving ecosystems.

Green-grey infrastructure in action

Green-grey infrastructure combines engineered ("grey") solutions with nature-based ("green") approaches to enhance climate resilience. In Kenya's Tana River Basin, a WEFE-aligned project integrated dams (grey infrastructure) with reforestation (green infrastructure) to reduce flood risks and siltation. The Upper Tana-Nairobi Water Fund, supported by the World Bank, demonstrated that reforesting 10,000 hectares of degraded watersheds reduced sediment loads by 30%, improved hydropower reliability by 25%, and secured water supplies for Nairobi city (World Bank 2023). This dual approach highlights how ecosystem restoration can enhance the performance of

traditional infrastructure, ensuring sustainable energy and water access.

Similarly, the Great Green Wall Initiative across the Sahel employs ecosystem-based adaptation to combat desertification and drought. Restoring 20 million hectares of degraded land has enhanced groundwater recharge, bolstered agricultural productivity, and reduced pastoralist conflicts (UNCCD 2023).

In Niger, farmer-managed natural regeneration (FMNR) techniques have increased crop yields by 50–100% in some areas (Rinaudo et al. 2021), proving that green infrastructure can simultaneously address food insecurity, water scarcity, and energy needs (e.g., reducing dependence on firewood).

Collectively, these cases demonstrate that hybrid infrastructure solutions can simultaneously protect ecosystems, strengthen livelihoods, and enhance climate resilience at scale.

Early warning systems

Early warning systems (EWS) are vital for anticipating and managing WEFE-related climate risks. In the Lake Chad Basin, where shrinking water resources threaten the livelihoods of 30 million people, a satellite-based nexus monitoring system (ILRI n.d.) tracks water availability, crop stress, and conflict hotspots. This system integrates hydrological data with climate forecasts to predict droughts, enabling governments and farmers to adjust irrigation schedules and prevent crop failures. For example, in Northeast Nigeria, EWS alerts reduced post-harvest losses by 20% during the 2022 drought (FAO 2023).

In South Africa, a Flood and Drought Portal utilizes Artificial Intelligence (AI)-driven modeling to predict the impacts of extreme weather on agriculture and urban water supplies (Agbehadji et al. 2024). During the 2023 Cape Town floods, real-time data enabled authorities to reroute reservoir releases, preventing dam overflows while ensuring uninterrupted hydropower generation.

These examples show how WEFE-informed EWS can shift disaster management from reactive crisis response to proactive resource allocation before disasters strike, thereby reducing losses, protecting livelihoods, and strengthening resilience.

Catalyzing inclusive economic growth

The WEFE Nexus can be a powerful driver of inclusive economic growth, particularly in developing regions where resource scarcity, unemployment, and social inequities intersect. By integrating water, energy, and food systems with ecosystem stewardship, WEFE initiatives can create jobs, empower marginalized communities, and reduce gender disparities.

In Africa, projects related to wastewater reuse demonstrate how nexus solutions can transform rural economies while advancing gender equity. A transformative example is Senegal's wastewater reuse program in which treated urban wastewater irrigates 1,200 hectares of vegetable gardens in peri-urban areas. This initiative, supported by the African Union, has created over 5,000 jobs, primarily for women engaged in urban farming and food vending. By converting waste into an economic asset, the project improves water use efficiency and strengthens local food markets. Women participants saw their incomes rise by 60%, illustrating how WEFE projects can uplift entire communities (AU 2022).

Governments and development partners should prioritize WEFE investments that embed circular economy principles. These deliver simultaneous gains in livelihoods, gender equity, and resource efficiency, turning environmental constraints into engines of inclusive growth.

Policy priorities

The African Union's Climate Change Strategy (2022–2032) underscores the need for cross-sectoral planning, urging member states to align water, energy, and agricultural policies with ecosystem limits. Building on this, the following policy priorities are identified for scaling WEFE Nexus across Africa:

- **Institutional innovation:** establish national WEFE coordination units, inspired by Zambia's successful cross-ministerial platform that reduced project approval delays by 60%.
- **Integrated financing:** develop financial mechanisms that integrate climate adaptation funds with infrastructure financing, as exemplified by Morocco's USD 300 million green bond for solar canal projects.
- **Community-centered design:** embed local knowledge in decision-making processes, as demonstrated by Lake Chad Basin's participatory early warning system which had an accuracy rate of 82% in predicting water-related conflicts.
- **Enhanced knowledge and data management:** build robust cross-sectoral data collection and sharing systems to support evidence-based decision-making, following the approach outlined in Mabhaudhi and Elias (2024).

These recommendations align with the African Union's Agenda 2063 and contribute to multiple Sustainable Development Goals (SDGs), specifically SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), and SDG 13 (Climate Action). The evidence presented makes a compelling case for mainstreaming nexus approaches in Africa's infrastructure development agendas to achieve water security, climate resilience, and inclusive growth amongst growing resource constraints.

To unlock the full socioeconomic benefits of the WEFE Nexus, governments and development partners should:

- **Prioritize gender-responsive design:** ensure women and youth are primary beneficiaries of WEFE projects, similar to Senegal's wastewater reuse schemes.

- **Invest in skills development:** expand vocational and leadership training for green jobs, modeled on the CGIAR-Nexus program, to sustain rural employment in solar energy and irrigation management sectors.

- **Leverage public-private partnerships:** mobilize private capital for scalable WEFE solutions, such as Ethiopia's solar irrigation cooperatives.

- **Localize solutions:** recognize that while WEFE impacts transcend borders, effective interventions must be tailored to local cultural, economic, and environmental contexts (Perrone and Hornberger 2013). This requires shifting from traditional cost-benefit (CB) analyses toward systemic accounting that includes non-market values such as ecological integrity and social equity.

Overcoming barriers and scaling the WEFE Nexus in Africa

Despite the promising outcomes across multiple African contexts, several persistent barriers impede scaling of the WEFE Nexus approach. Foremost is the challenge of institutional fragmentation, where water, energy, agriculture, and environmental sectors operate in isolation, with overlapping mandates and misaligned priorities (UNECA 2022; Bizikova et al. 2013). This disconnect often leads to coordination failures, inefficient investments, and conflicting infrastructure designs—such as dams optimized for hydropower undermining irrigation or ecosystem needs (Hoff 2011). Political will and leadership continuity are also critical constraints. While pilot projects and task forces have shown success (e.g., Zambia's National Nexus Task Force), many countries lack formal mandates or budget allocations to institutionalize cross-sectoral coordination (ILRI n.d.). Capacity gaps—technical, human, and financial—further limit the ability of local and national governments to implement integrated planning tools, monitor outcomes, or adaptively manage nexus interventions (AfDB 2023). Moreover, risks of elite capture and lack of inclusive governance threaten to divert resources away from intended beneficiaries. Without transparent oversight and community involvement, there is a danger that WEFE investments may reinforce existing inequities rather than resolve them (AU 2022). To address these challenges and unlock the transformative potential of the WEFE Nexus, the African Union Commission and its member states should consider the following next steps:

- Establish national WEFE commissions or units, embedded within planning ministries, with authority to align sectoral policies and infrastructure investments.
- Mainstream nexus approaches within National Development Plans, Nationally Determined Contributions (NDCs), and investment frameworks, ensuring alignment with the African Union's Agenda 2063 and SDG targets (AU 2022; UNFCCC 2023).
- Expand data and analytics platforms, such as decision support systems and basin-level monitoring tools, to facilitate integrated planning and track cross-sectoral outcomes (Nexus Resource Platform 2022).
- Mobilize blended finance and green bonds targeted at multipurpose infrastructure that delivers co-benefits across water, energy, agriculture, and ecosystems (AfDB 2023).
- Promote cross-sectoral integration through multistakeholder platforms, and foster inclusive governance mechanisms, including participatory planning with women, youth, and marginalized groups, to enhance accountability and ownership).

Only by systematically addressing these barriers can African countries scale WEFE innovations beyond pilot projects, ensuring they become foundational pillars of sustainable, climate-resilient, and inclusive infrastructure development.

Conclusion

The WEFE Nexus is more than a sustainability framework. It is a catalyst for inclusive, equitable economic transformation. From Nigeria's solar-powered farms to Senegal's wastewater economies, integrated resource management creates jobs, empowers women, and revitalizes rural areas. By embedding WEFE principles in national development plans, African nations can convert escalating resource pressures into drivers of sustainable growth, directly advancing the UN Sustainable Development Goals—especially SDG 1 (No Poverty), SDG 5 (Gender Equality), and SDG 8 (Decent Work and Economic Growth). Africa's WEFE Nexus innovations—from Kenya's green-grey infrastructure to Lake Chad's cutting-edge early warning system—demonstrate that integrated approaches enhance climate resilience while advancing SDGs 2 (Zero Hunger), 6 (Clean Water and Sanitation), and 7 (Affordable and Clean Energy). To replicate and scale these successes, governments must prioritize funding for nexus-driven projects, community-led adaptation, and transboundary data sharing. By bridging science, policy, and local knowledge, the WEFE Nexus offers a powerful and actionable pathway to transform climate risks into opportunities for resilient and sustainable development throughout Africa.

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