

Water-Energy-Food Nexus for Climate resilience in Kenya's Ewaso Ng'iro North Basin: Breaking Institutional Silos for Sustainable Development

Policy Brief

Key Messages

- The **Water-Energy-Food (WEF) Nexus** is essential for achieving multiple Sustainable Development Goals (SDGs) in Kenya's Ewaso Ng'iro North Basin, specifically SDG 6 (Water), SDG 7 (Energy), SDG 2 (Food), and supporting SDG 13 (Climate Action) and SDG 15 (Life on Land).
- **Traditional siloed planning** by individual counties fails to account for critical upstream-downstream dependencies and cross-sectoral synergies
- **Integrated WEAP modeling** proves that sectoral improvements alone are insufficient; inter-county cooperation is essential for equitable and resilient outcomes.
- **Governance challenges**—including lack of policy coherence, weak inter-county coordination, and power imbalance are the primary barriers to implementation, not technical capacity or resource availability.
- Climate change is projected to reduce basin water availability by 15-25% by 2050. The most resilient pathway (Scenario 6) combines cooperation with ecosystem restoration, delivering genuine win-win outcomes for people and nature that neither approach achieves alone.





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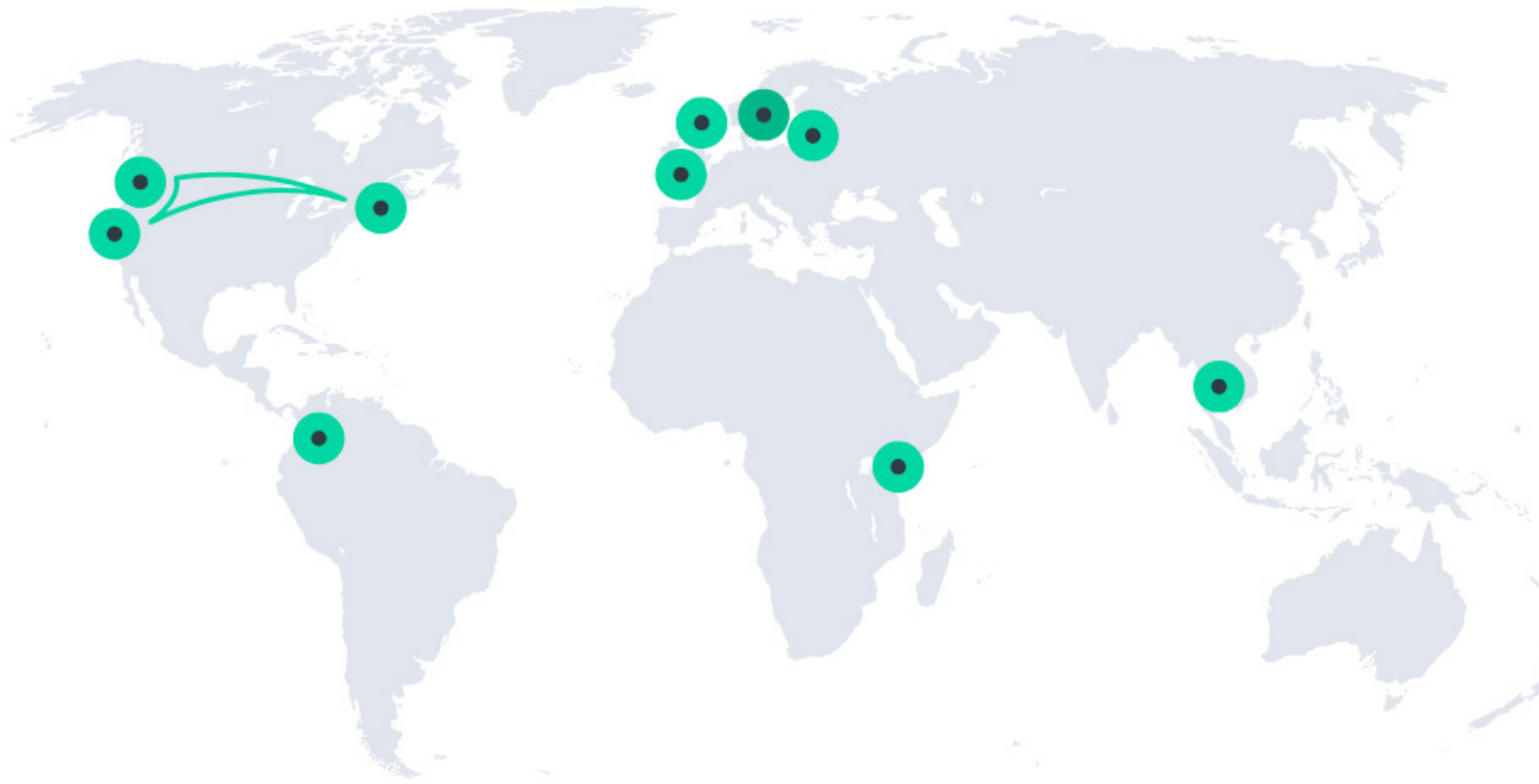
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About the Project

Applying the water-energy-food nexus to promote ecosystem-based adaptation in the Ewaso Ng'iro North Catchment, Kenya

This project seeks to support the Government of Kenya, five county governments (Laikipia, Samburu, Isiolo, Meru and Nyeri), local communities, and agro-based private enterprises to promote ecosystem-based adaptation practices and integrated planning for water, energy, agriculture and land use for resilient livelihoods in the Ewaso Ng'iro North Catchment Area.

The project seeks to apply ecosystem-based adaptation (EbA) and the nexus approaches to facilitate the co-production of resilient water-energy-food (WEF) knowledge with stakeholders (policymakers, local community groups, private sector, and non-governmental organizations) to inform decision and policymaking.

The project will contribute towards several development objectives which are in line with the Kenya Vision 2030 priorities, the Ewaso Ng'iro North Development Area (ENNDA) Integrated Regional Development Plan (2010-2040), the ENNDA catchment management strategy and the reformulation and implementation of CIDPs. These include increasing food security, especially pastoral livestock production; resilience through livelihoods diversification; employment creation through EbA solutions; agricultural growth; the conservation and safeguarding of critical habitats, including wildlife-protected areas and community wildlife conservancies. At the governance level, the nexus approach is expected to promote cooperation among actors and policy coherence across “policy silos”, i.e. sectors, levels and scales and the key added value of the nexus approach is in integrating across the various plans and strategies, promoting synergies and generating co-benefits.

Expected results

- WEF nexus models and development scenarios for Ewaso Ng'iro North Catchment Area (ENNCA)
- Identification, validation, and promotion of innovative Ecosystem-based nexus solutions among key stakeholders in the ENNCA region
- Increased awareness of cross-sectoral interactions (water, energy, agriculture, and land) during the implementation, upscaling, out scaling, and transfer of ecosystem-based nexus solutions at the sub-national and national level





1.

Introduction: The WEF Nexus Challenge in the Ewaso Ngiro North Basin

The Ewaso Ngiro North Basin faces the critical global challenge of managing simultaneous demands for water, energy, and food amidst accelerating climate change. This basin is home to 1.5 million people across five counties: Laikipia, Nyeri, Meru, Isiolo, and Samburu.

- **Intense Competition:** Agriculture accounts for 54% of basin water withdrawals. Water availability directly determines food security, particularly for pastoral communities in the Arid and Semi-Arid Lands (ASALs). Yet, cities and commercial agriculture in the upper catchment (Laikipia, Nyeri, Meru) demand increasingly more resources, intensifying competition.
- **The Climate Imperative:** Feeding a projected population of 2.3 million by 2050 will require substantial increases in agricultural productivity, but climate projections indicate a 15-25% reduction in water availability over the same period.
- **The Solution:** The WEF Nexus provides an integrated planning and policy framework to move beyond fragmented 'silo' planning, identify trade-offs, and explore synergies across sectors. Crucially, it addresses the equitable management of finite and stressed natural resources within planetary boundaries.

Links Between the WEF Nexus, SDGs, and Climate Action

The WEF Nexus supports SDG implementation by:

1. **Identifying Trade-offs** at the policy design stage, e.g., upstream irrigation and hydropower expansion (Laikipia, Meru, Nyeri) conflicting with downstream food security (Isiolo, Samburu) and ecosystem health (SDG 2 and SDG 15).
2. **Identifying Multi-Benefit Solutions**, e.g., small-scale hydropower advancing SDG 7 and SDG 13, and supporting SDG 2 through reliable power for agricultural processing.
3. **Linking SDGs** through implementation processes that transcend silos, e.g., inter-county water allocation agreements simultaneously addressing SDG 16 (peace), SDG 17 (partnerships), and resource-specific SDGs.

The approach is vital for implementing Kenya's climate commitments, as agriculture and energy drive climate change, while water and agriculture are among the most vulnerable sectors. Integrated solutions like climate-smart agriculture require coordinated planning across county governments and Water Resource Users Associations (WRUAs).



2.

Status of WEF Nexus Implementation and Challenges

Despite its potential, the WEF Nexus approach has not been mainstreamed into county-level policies, programs, or institutions. County Integrated Development Plans (CIDPs) for 2018-2022 address water, energy, and agriculture independently, often with conflicting resource use targets.

Context-Specific Challenges

The Ewaso Ngiro North Basin, with its water-scarce Arid and Semi-Arid Lands, and vulnerable pastoral communities, faces distinct challenges:

- The highest priority is simultaneously closing large energy, water, and food security gaps in downstream counties (Isiolo, Samburu) while managing competing demands from upstream commercial agriculture (Laikipia, Meru) and domestic supply (Nyeri).
- Hydropower potential is concentrated in upper catchment counties, creating an **asymmetry** where upstream development may impact downstream water availability without reciprocal benefits.

Governance: The Critical Bottleneck

Governance is the primary barrier to implementation, not technical capacity. WEF Nexus decisions are fundamentally political because resource scarcity means allocation creates winners and losers.

Key governance challenges include:

- **Lack of Policy Coherence:** County plans pursue incompatible targets (e.g., Laikipia's irrigation conflicts with Samburu's livestock sector) with no mechanism for reconciliation.
- **Weak Inter-County Coordination:** Upstream counties capture benefits while downstream counties bear the costs (reduced water availability). Without benefit-sharing mechanisms, cooperation remains fragile.
- **Power Imbalances:** Upstream commercial agriculture, hydropower developers, and urban utilities hold substantially more political and economic power than downstream pastoral communities and WRUAs, often subordinating technical analyses to political dynamics.
- **Gender imbalance:** Gender dimensions i.e., women's primary roles in water, fuelwood, and food are usually overlooked, leading to inequitable outcomes and suboptimal technology choices.

3.

Integrated WEF Nexus Modeling: Approach and Scenarios

The integrated **Water Evaluation and Adaptation Planning (WEAP)** tool for the basin incorporates hydrology, demands, allocation rules, and infrastructure across all five counties, providing a basin-wide perspective.

Scenario Implementation

Six narrative scenarios were co-developed to test different development pathways through 2050, building sequentially to isolate the effects of different interventions:

Scenario	Core Interventions (Building on Previous)	Key Policy Implications
S1: Baseline	Continuation of current trends, no new development, no coordination, Climate change.	Reference for measuring benefits of integrated approaches.
S2: County Focus	S1 + Upstream hydropower, shift to higher-value crops (cassava), irrigation expansion, increased water sources but no coordination.	Reveals conflicts between upstream development and downstream water security.
S3: Water & Agriculture Improvements	S1 + Comprehensive water efficiency (drip irrigation, reduced conveyance loss), improved crop yields, new water storage.	Shows the limits of technical solutions without governance.
S4: Energy & Climate Improvements	S2 + dynamic integration with energy planning (WEAP-LEAP: HP expansion), climate-smart agriculture.	Captures full WEF Nexus trade-offs but still lacks coordinated allocation.
S5: Cooperation	S3 + CRITICAL CHANGE: Allocation rules modified; upstream reservoirs operate to meet downstream demands (Isiolo/Samburu), enhanced inter-county corporation on WEF nexus issues, improved coordination.	Quantifies the benefits of inter-county cooperation and equitable benefit-sharing.
S6: Ecosystem Restoration	S4 + CRITICAL ADDITION: Highest priority assigned to environmental flow requirements at county borders (FDC-Shift method).	Tests on whether 'people vs. nature' trade-offs are inevitable; balances ecosystem needs with human water security.



4.

Key Findings from Scenario Analysis

(i) The Limits of Technical Solutions Without Governance Reform

- Scenario 3 (Water and Agricultural Improvements) significantly increases efficiency, but these gains disproportionately benefit upstream counties where the improvements are made.
- Downstream counties see only modest improvements, and unmet water demands remain high because upstream abstraction retains priority.
- **Conclusion:** Technical solutions create the potential for improved outcomes, but **governance mechanisms determine who actually benefits**. Efficiency without equity reinforces existing disparities.

(ii) Cooperation Delivers Equitable Benefits

- Scenario 5 (Cooperation) shows dramatic, equitable improvements by coordinating allocation across county lines.
 - o **Downstream:** Samburu County sees a **48% reduction** in unmet livestock watering demand; Isiolo sees a **42% reduction** in agricultural water deficits.
 - o **Upstream:** Laikipia, Nyeri, and Meru maintain 90%+ of their irrigation targets, achieving this through efficiency gains shared equitably.
- **Win-Win Outcomes:** This is not zero-sum. Total beneficial water use increases basin-wide under cooperation, and basin-wide agricultural value-added increases by **12%** compared to the baseline by 2050, despite climate change impacts.

(iii) Ecosystems and People Can Both Benefit

- Scenario 6 (Ecosystem Restoration) demonstrates that prioritizing environmental flows does not necessitate major human water security trade-offs when combined with cooperation and efficiency gains (Scenario 5).
 - o **Ecosystem:** S6 reduces environmental flow deficits by **67%** compared to the baseline, maintaining critical wildlife habitats.
 - o **Human Security:** S6 achieves this protection while maintaining **85-90%** of the high agricultural production targets set in S5.
- **Conclusion:** 'People vs. nature' is a false choice. The pragmatic FDC-Shift method for setting flows balances ecosystem needs with existing human dependencies, avoiding political resistance.

(iv) Hydropower-Water Trade-offs Require Careful Management

- The planned small-scale hydropower (27-54 MW) can be compatible with downstream water security when integrated with basin-wide allocation (S5/S6).
- However, under uncoordinated development (S2), hydropower operations can reduce downstream flows during critical dry seasons when energy demand peaks for irrigation pumping.
- **Insight:** The WEAP-LEAP integration reveals a timing mismatch: peak hydropower generation is during high-flow wet seasons, while peak energy needs for pumping are during low-flow dry seasons. Renewable energy development must be planned with careful attention to water availability and competing uses.



5.

Priority Actions for Scaling Up the WEF Nexus Approach

To translate modeling insights into policy and practice, governance challenges must be addressed through a pragmatic, stepwise approach:

I. Political and Institutional Actions

- 1. Establish an Inter-County Water Allocation Framework:** Formalize the coordinated allocation approach of Scenario 5. Create a joint committee of the five county governments, facilitated by the Water Resources Authority (WRA), to implement basin-wide optimization principles.
- 2. Link Hydropower Development to Downstream Benefit-Sharing:** Condition approval for new hydropower sites on maintaining minimum flows for downstream users and requiring developers to contribute to downstream water infrastructure as mitigation.
- 3. Integrate WEF Nexus Principles into CIDPs:** Update the 2023-2027 County Integrated Development Plans (CIDPs) to include cross-sectoral WEF targets based on scenario modeling results, ensuring coherence between agriculture, water, and energy plans.
- 4. Strengthen and Empower WRUAs as Bridging Institutions:** Expand WRUA mandates beyond water to encompass broader WEF coordination, providing corresponding capacity building and resources. Train leaders interpret modeling results and facilitate multi-stakeholder dialogue.
- 5. Address Power Imbalances through Participatory Governance:** Ensure downstream pastoral communities have a genuine voice in allocation decisions. Consider mechanisms in the inter-county framework to counterbalance upstream economic power.

II. Knowledge Management and Data Systems

- 1. Establish Real-Time Monitoring Systems:** Install real-time monitoring for water abstraction, groundwater levels, and hydropower generation. Make data publicly accessible to support evidence-based decision-making and accountability.
- 2. Create a Basin Knowledge Platform:** Develop an accessible repository of WEF data, WEAP modeling results, and policy documents, making scenario comparison results available in useful visual formats (infographics, briefs).
- 3. Update and Maintain the WEAP Model:** Establish an institutional home for the ongoing maintenance and regular update of the WEAP model to inform actual planning decisions.

III. Technology Implementation and Financing

- 1. Prioritize Water and Agricultural Efficiency Investments in Upstream Counties:** Target technical assistance and subsidies for drip irrigation, reduced conveyance losses, and improved crop varieties in Laikipia, Meru, and Nyeri. Frame this as ‘efficiency creates availability for downstream users’ and links it to downstream allocation commitments.
- 2. Develop Integrated Climate Finance Proposals:** Package WEF interventions as integrated projects (e.g., combining renewable energy, efficient irrigation, and ecosystem restoration) to meet Green Climate Fund criteria, leveraging the quantified adaptation and mitigation benefits from scenario modeling.
- 3. Establish Payment for Ecosystem Services (PES) Mechanisms:** Use tourism revenues from downstream wildlife areas to support watershed management investments in upstream counties, creating financial incentives for upstream counties to support environmental flows.

IV. Gender and Social Equity

- 1. Mainstream Gender Analysis in all WEF Interventions:** Systematically assess women’s labor contributions (water, fuelwood, food) and ensure technology choices reduce women’s drudgery (e.g., solar pumping) and support their economic empowerment.
- 2. Ensure Women’s Participation in Allocation Governance:** Require women’s representation in the inter-county allocation framework and WRUA leadership to reflect their differing priorities (domestic water security vs. irrigation for cash crops) in allocation decisions.



6.

Conclusion: From Evidence to Action

The integrated WEAP modeling for the Ewaso Ngiro North Basin provides clear evidence that the WEF Nexus approach is not merely conceptual but practically essential for achieving sustainable and equitable development under climate change

Key Conclusion from Modeling	Policy Implication
Technical improvements alone are insufficient (S3)	Technology creates potential; governance determines who benefits. Focus must shift to institutional and political constraints.
Cooperation delivers win-win outcomes (S5)	Formalize the inter-county allocation framework to operationalize cooperation principles.
Ecosystems and people both benefit from integration (S6)	Implement environmental flow requirements and leverage Payment for Ecosystem Services mechanisms to link upstream ecosystem protection with downstream livelihoods and tourism.
Energy-water integration is critical (S4)	Link hydropower development permissions to downstream benefit-sharing and coordinated operation.

The challenge is no longer technical but lies in political will and institutional frameworks. The five counties, supported by this evidence, have the opportunity to create a replicable model for climate resilience and equitable development across Kenya's drylands and East Africa more broadly.

The choice is not between development and sustainability, or between upstream and downstream, or between people and nature. Through integrated planning and coordinated action, the Ewaso Ngiro North Basin can achieve all of these objectives simultaneously.

