

# Building Resilience in the Water- Energy-Food Security Nexus

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## Summary

In a world increasingly affected by resource constraints and climate variability, such as recent severe droughts and floods in various parts of Southern and Eastern Africa, the water-energy-food ‘nexus’ – defined as the interconnections among these three systems that are vital for human welfare – is increasingly important for policy-makers seeking to promote sustainable development in their countries. Treating water, energy and food systems independently of each other can result in critical system linkages and vulnerabilities being underappreciated, and can possibly lead to the formulation and implementation of ineffectual or even counterproductive policies and measures. Policy-makers need to understand the dynamic interactions occurring within the nexus so that they can identify the key cross-cutting vulnerabilities and risks facing their countries in terms of water, food and energy security. This will enable them to formulate strategies and policies to mitigate these nexus risks and to promote economic efficiency, social equity and environmental sustainability in food, energy and water provision to their citizens.

## Challenges for the policy-maker

- Multiple global, regional and national drivers place WEF security at risk, while climate change creates uncertainty, which complicates decision-making.
- Institutional capacity is sometimes lacking to deal with complex developmental challenges.
- Policy-making often occurs in institutional silos, resulting in inadequate coordination to deal with nexus linkages.
- Threats to WEF nexus security often straddle international borders, with the potential to create geopolitical tensions.
- There are usually competing vested interests, with most policy interventions resulting in both winners and losers.
- There can be competing intellectual paradigms and ideologies, some of which are not fit-for-purpose.
- Certain solutions to one aspect of the nexus (e.g. energy security) may create problems for another element (e.g. water security).
- Droughts are causing shortages not only of water, but also of food and hydroelectricity.

## Actions for the policy-maker

- Promote an integrated ‘nexus approach’ to policy-making that is informed by multidisciplinary scientific research based on the best available data.
- Build well-functioning institutions, effective governance systems and integrated policy frameworks.
- Enhance vertical and horizontal policy coordination across nexus-related areas.
- Engage in multilateral forums to improve international policy coordination in managing the nexus.
- Foster cooperation with stakeholders from all sectors of society to ensure sustainable and equitable governance of resources.
- Design nexus interventions within an ‘inclusive green economy’ framework.
- Adopt a mix of policy instruments, including public investment, economic incentives and regulatory mechanisms.
- Promote technical solutions that minimise trade-offs and maximise synergies across the nexus.
- Invest in water storage and efficiency, adopt drought-resistant crops and diversify sources of energy (e.g. solar photovoltaics and gas).

## Insights from the research paper

Energy, food and water systems need to be understood in terms of their entire value chains, including production, processing, storage, distribution, consumption and waste disposal stages and their supporting infrastructures. Nexus analysis highlights the interconnections and interdependencies at all of these life cycle stages. For example, energy inputs – primarily petroleum fuels and electricity – are required at all stages of the food system value chain, including pumping water for irrigation; powering tractors for tillage and harvesters; production of synthetic fertilisers and pesticides to produce crops and antibiotics to treat livestock; refrigeration; food processing; transporting and distributing food products; cooking; and fuel for transporting food waste to disposal sites. Energy inputs are also needed at various stages of the water system value chain, including extraction from lakes, rivers and aquifers; desalination; water treatment; construction of dams, reservoirs and pipelines; pumping for distribution to consumers; and waste-water treatment. Water, in turn, is essential for agricultural production and food processing, and for the extraction and processing of fossil fuels, hydropower generation and cooling in thermal power plants. A number of agricultural crops are converted into bioenergy, which also depends on large amounts of water. Furthermore, certain energy industries – especially fossil fuels – and high-input agricultural production can have adverse impacts on water and soil quality.

Several major global and local drivers are placing increasing pressure on nexus linkages and posing growing challenges for food, energy and water security. On the demand side, these drivers include expanding populations, economic growth, rising affluence, shifting consumption patterns (generally towards greater resource intensity), urbanisation and globalisation. Supply-side drivers include the depletion of conventional fossil fuel reserves (resulting in increasing reliance on more polluting and water-intensive unconventional oil and gas resources), and the degradation of soils, fresh water supplies and ecosystems. Climate change is exerting increasing pressure on water resources and can have destabilising impacts on agricultural production and certain forms of energy generation, especially hydropower. Shocks to the nexus arise principally from extreme weather events such as droughts and floods, and oil and food price spikes – which are sometimes triggered by geopolitical conflict and financial speculation.

The main nexus-related risks to energy, food and water security vary according to countries' levels of development. Low-income, largely agrarian economies typically have high levels of dependence on traditional biomass energy, which renders them vulnerable to deforestation, energy poverty (especially a lack of access to electricity), low-productivity rain-fed agriculture with poor nutritional outcomes, and limited access to improved water sources. Droughts can have especially severe impacts in such countries. More advanced developing economies with established industrial capacity generally perform reasonably well in terms of basic energy, food and water security access and consumption levels, with the notable exception of several southern African nations that have high levels of income inequality and poverty. However, many of these middle income countries rely heavily on fossil fuels to power high-input, mechanised agriculture and industries, and complex water supply infrastructures – and are thus exposed to international oil price shocks. Many also face energy-related pollution threats to their water and soil resources.

Nexus interventions will be much more coherent and effective if they are designed and implemented within an overarching paradigm aimed at a transition to 'inclusive green economies'. This involves expanding access to food, water and energy services while transforming economic systems to be more resource efficient, less carbon intensive

and less damaging to the environment. A mix of policy instruments should be utilised, including public investment in infrastructure and innovation, economic incentives such as taxes and subsidies, regulatory mechanisms such as efficiency and emission standards, and education and awareness programmes.

A wide range of technical measures can be adopted to mitigate nexus-related risks and improve energy, food and water security in developing countries. For example, an expansion of small-scale agroecological farming can help to reduce reliance on energy in agriculture. A transition to renewable energy sources – especially solar photovoltaic, wind and geothermal power – can reduce the water dependence of energy systems. Protecting and restoring ecosystems such as wetlands can help to boost water security. Reducing waste and improving efficiency is essential at all stages of the energy, food and water supply chains.

To be sure, there are no one-size-fits-all solutions; policy responses must be sensitive to context. For example, there can be significant spatial differences in appropriate nexus mitigation strategies and policy interventions. In rural areas, the key issue is optimising land use to provide a range of services, while in urban areas the emphasis is on creating resource-efficient, low-carbon cities. The main priority for countries with a largely agrarian regime is to expand access to food, energy and water among their populations, while limiting negative impacts on ecosystems. By contrast, in countries with more developed industrial regimes that rely heavily on fossil fuels, the key nexus security challenges are to limit the vulnerability to international energy price volatility, reduce energy and resource intensity, and reduce the negative impacts of fossil fuel use on soils and water resources.

Nexus mitigation interventions will form a critical part of societal transitions toward greater resilience and sustainability in the face of global and local environmental, resource and population pressures.

*For further evidence-based research on the WEF nexus, please consult the QG Knowledge Hub:*  
[www.quantumglobalgroup.com/knowledge-hub/research-papers/policy-brief/](http://www.quantumglobalgroup.com/knowledge-hub/research-papers/policy-brief/)