



Policy Brief

MOVING TOWARDS A VIRTUOUS CLIMATE-WATER-ENERGY-FOOD NEXUS

Task Force 3

Governing Climate Targets, Energy
Transition, and Environmental
Protection

MOVING TOWARDS A VIRTUOUS CLIMATE- WATER-ENERGY-FOOD NEXUS

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Abstract

Water, energy and food (WEF) nexus and climate change are strongly interlinked through multiple bidirectional interactions. So far, countries' approach to WEF policy-making has been largely supply-oriented, in silos, and completely disconnected from climate change issues, triggering a vicious circle that has favoured trade-offs rather than synergies across resources, sectors, and even societal and environmental goals. These challenges call for a paradigm shift to turn the conventional WEF nexus into a virtuous circle. Moreover, global warming and climate variability imply the need for adding to the nexus the climatic dimension, which requires a further inter-sectoral response. To face these challenges four main actions are identified: mainstreaming climate change into the WEF nexus; decouple water, energy and food production from fossil fuels; recognise the role of forests in water security, and thus food and energy security, through their ecosystem services; develop sustainable WEF intra-regional and inter-regional cooperation/integration models based on the principle of comparative advantages. Specific recommendations are drawn for the way forward.

Challenges

Water, energy and food (WEF) are strictly interrelated through different types of nexus linkages, which require different analytical tools to systematically analyse the interactions between natural and human systems, and innovative solutions to move towards a more coordinated management and sustainable use of natural resources across sectors and scales. The most visible kind of relationship in the WEF nexus are direct dependencies, as energy depends on water for power generation, the extraction, transport and processing of fossil fuels, and the irrigation of biofuel crops; water provision depends on energy for its abstraction, purification and distribution; and food production needs water, productive land and energy to grow crops, maintain livestock and process food. In addition to direct dependencies, the nexus is further complicated by the fact that WEF are affected by several dynamic exogenous variables (Burnett and Wada, 2018). Population growth, migration flows, socio-economic development, anthropogenic pressures and climate change impacts influence demand, distribution, availability and accessibility of the WEF resources over time and space. As the demand for resources increases with population growth and changing consumption patterns, in a context of resources scarcity and climate change impacts, not only the nexus interlinkages intensify, but also direct competitions or trade-offs between sectors increase, limiting countries' ability to meet the growing demand in a sustainable manner (Markantonis et al., 2019). Particularly, climate change both affects and is affected by the WEF nexus through multiple bidirectional interactions that intertwine within the web of WEF interconnections (Rasul and Sharma, 2016). Climate change drives a series of phenomena that have negative effects on WEF security, exacerbating nexus conflicts: rising temperatures, changes in precipitation patterns, extreme weather events and rising sea-levels may gradually alter the balance between the nexus resources, and even the nature of their interactions (Cramer et al., 2018). Moreover, current sectoral approaches to climate change mitigation and adaptation may amplify rather than reduce negative externalities and trade-offs within the nexus. While some sector-oriented mitigation and adaptation measures may have the potential to trigger synergistic “win-win” opportunities across one or more of the other components of the nexus, other measures, such as hydropower, first generation biofuels, the shift to non-conventional water resources and agricultural intensification, are not always nexus-smart. At the same time, WEF production may increase greenhouse gas (GHG) emissions contributing to climate change, while effective climate change mitigation and adaptation strategies require the efficient use of land, water and energy and coordinated efforts to minimise trade-offs and maximise synergies.

Although the raising awareness of the WEF nexus challenges and the priority given to climate change in the political agenda, little attention has been given so far to the linkages between

the WEF nexus and climate change as well as to the opportunity of developing nexus-based mitigation and adaptation responses. The need to meet the rapidly growing demand for WEF in an increasingly resource-constrained climate change scenario, associated with WEF conventional policy and decision making in silos, have fueled a vicious circle. These challenges call for a paradigm shift to turn the conventional WEF nexus into a virtuous circle in line with the United Nations Sustainable Development Goals (SDGs) and the COP21 Paris climate change commitments.

Addressing climate change and turning the WEF nexus into a virtuous circle call for a number of actions, such as adding into the WEF nexus the climatic dimension; promoting renewable energy as a means of integrated solutions for enhancing security of supply across the three sectors, while simultaneously supporting global climate ambitions; recognising the role of forests in WEF security through their ecosystem services; applying the nexus thinking beyond national borders to encourage WEF exchanges between countries in an economically efficient and environmentally sound manner.

Proposal

Turning the WEF nexus from a vicious cycle of scarcity, competition and conflict into a virtuous cycle of resilience, sustainable resources management, cooperation and security is a prerequisite to allow countries to implement their commitments under the Paris Agreement and Agenda 2030 and to strengthen countries' ability to deal with the impacts of climate change. To face these challenges three main actions are identified:

1. mainstreaming climate change into the WEF nexus: identifying and quantifying the interactions between the WEF nexus and climate change as well as developing nexus-based mitigation and adaptation approaches, which integrate a nexus perspective into climate change policy and plans;
2. decoupling WEF production from fossil fuels: increasing renewable energy as an effective tool to face countries' pressing WEF and climate change challenges;
3. developing sustainable WEF intra-regional and inter-regional cooperation/integration models based on the principle of comparative advantages: applying the nexus thinking beyond national borders to promoting economically efficient and environment-friendly WEF exchanges between countries.

MAINSTREAMING CLIMATE CHANGE INTO THE WEF NEXUS

Countries and governments' approach to WEF management has been largely supply-oriented, in silos and completely disconnected from climate change policy, leading to several incoherencies: between WEF planning and social and environmental objectives and between WEF and climate change actions. Bridging these disconnects requires a shift in decision-making processes to explicitly consider the interlinkages and interdependencies between sectors, detect the interactions between the WEF nexus and climate change and develop nexus-oriented climate change responses, which integrate a nexus perspective into climate change mitigation and adaptation strategies.

To ensure the mainstreaming of climate change into the WEF nexus, it is recommended to undertake the following measures and actions:

- Deepen the knowledge and understanding of the interlinkages between the WEF nexus and climate change. Internalise this knowledge into mitigation and adaptation strategies.

- Strengthen institutional capacity for coordinating the nexus and climate change issues in a holistic way. This calls for applying capacity building instruments, notably technical training and education, to provide institutions with human resources having a greater capability to correctly plan, manage and allocate the available resources among the competing sectorial uses and for effective mitigation and adaptation actions.
- Improve governance and collaboration among stakeholders and between stakeholders and governments, encouraging strong coordination mechanisms, implemented also through nexus-based policy dialogues, where key stakeholders can identify and prioritise solutions together, accepting decisions that, although not optimal from a single sector policy goal, can give benefits from an overall nexus perspective (Mohtar and Daher, 2016).
- Strengthen policy integration between the WEF nexus and mitigation and adaptation mechanisms. This approach may be managed by integrating the nexus perspective into mitigation and adaptation plans, as well as by mitigation and adaptation perspectives into development plans for better policy integration. For effective integration, it is critical to recognise the importance of the nexus perspective, promote system-wise mitigation and adaptation approaches, integrate multiple policy objectives so that different responses and measures support each other, synergies are enhanced, and trade-offs are minimised (Ringler et al., 2013).

The Group of 20 (G20) can take a number of actions to strengthen the integration between the WEF nexus challenges and climate change issues, such as including the knowledge dimension as a fundamental tool in providing the necessary scientific support for promoting rational and inclusive dialogue and decision-making processes; building capacity for policy-makers and designing mechanisms to ensure proper coordination, complementarities and harmonisation among different sectoral strategies, policies and plans to turn the “nexus thinking” into “nexus doing”.

DECOUPLE WEF FROM FOSSIL FUEL

Since the WEF nexus includes the main drivers of climate change and the main sectors affected by the impact of global warming, and energy represents both a critical input along different stages of the water and food supply chain and by far the largest source of GHG, renewable energy technologies should be considered the first step towards sustainable integrated solutions able to enhance security and sustainability across sectors, while supporting global climate ambitions. In the MENA region, for example, renewable energy technologies may provide access to a cost-effective, secure and environmentally sustainable supply of energy, simultaneously triggering spill-over effects in the water and food sectors. The MENA countries have a high potential in renewable energy development, especially solar,

for the presence of vast desert lands with a solar radiation density ranging between 1,300 and 2,500 kWh/m² per year (IRENA, 2015). Generally, renewable energy technologies are less water intensive than conventional options. Water needs for solar photovoltaics (PV) and wind are negligible compared to conventional thermoelectric generation, withdrawing up to 200 times less water to produce the same amount of electricity (IRENA, 2015). In addition to contributing to significant water savings, clean energy can be used to increase non-conventional water supply, such as desalinated water, whose production is still affected by high economic and environmental costs as a result of the considerable amount of fossil energy necessary to feed the reverse osmosis. Great opportunities emerge from those projects aimed at increasing renewable energy in order to optimize the link between clean energy, food, and unconventional water. The use of renewables would not only satisfy the energy demand of those countries that do not have sufficient oil reserves, but also improve the resilience and adaptive capacity of those countries that due to environmental constraints and the scarcity of two strategic resources for human well-being – water and food – are more vulnerable to the impact of climate change.

To enhance the transition towards both renewable energy and non-conventional water, it is recommended to undertake the following measures and actions:

- Reform the subsidy and tax system to “internalize” environmental and social externalities, promote more sustainable production and consumption patterns across sectors, make the polluter-pays principle operational, and take into account equity considerations (Burnett and Wada, 2018).
- Encourage the development of renewable energy technologies with the help of international financing, the development of non-conventional and innovative means of financing, and the removal of institutional, technical, regulatory and economic barriers (Halalsheh et al., 2018).
- Strengthen the nexus between non-conventional energy (renewable) and non-conventional water sources (treated wastewater and desalinated water) to address climate change mitigation and adaptation. Cross-sectoral projects still penalised by sectoral institutional landscape, should be encouraged to promote win-win options for nexus security and mitigation and adaptation objectives, bridging institutions, engaging stakeholders at different levels, and favouring unconventional funding mechanisms for nexus solutions.
- Incorporate the key principles of the green and circular economy into the WEF nexus through multi-functional production systems and cross-resources and cross-sector recycling. Incentivise green and circular economy adoption in WEF projects applying a mix of different policy instruments, including market and non-market instruments and

strategies to harvest technological synergies, minimise waste and generate co-products and co-benefits.

The G20 should select and design effective economic instruments to minimise market distortions, incentivise conservation of resources, take into account equity considerations, and encourage private sector engagement; incentivise the development of renewable energy through non-conventional and innovative means of financing and the removal of institutional, technical, regulatory and economic barriers; scale up, replicate and fund projects based on the nexus approach and on the principles of the green and circular economy.

RECOGNISE THE ROLE OF FORESTS IN WEF SECURITY THROUGH THEIR ECOSYSTEM SERVICES

The increasing scarcity of natural resources and the rising competition among WEF in a scenario of population growth and climate change impacts pose serious threats to forests and their ecosystem services. Despite the relative abundance of soil and water resources which characterises tropical forest countries, because of increasing demand associated with pressures on resources from climate change and environmental degradation, the relevance of competition for natural resources is increasing, putting real challenges for reconciling development goals across WEF sectors and environmental protection. Policy gaps and conflicts between agricultural production and forest conservation targets call for breaking trade-offs over land and water for agriculture and energy production to achieve WEF security targets and meet forest-conservation concerns (Bellfield et al., 2017). Forests play a vital role in water security and thus food and energy security through their water regulation and purification services. While investing in water infrastructure such as irrigation networks and water storage is a shared goal across the WEF sectors, water security objectives clearly recognise the role of investment in forest conservation as “natural” infrastructure for improving downstream water supply for agriculture and energy production, generating co-benefits such as emissions reductions, biodiversity protection and forest-based employment and livelihoods.

The WEF nexus analysis carried out in tropical forest countries such as Brazil, Colombia, Peru and Indonesia, highlights the need to implement strategies able to both mitigate land use trade-offs and support multiple sectoral targets, including the prioritisation of degraded land for agricultural expansion, increases in agricultural productivity and energy-efficiency, and investment in forest conservation for improving downstream water supply (Sabogal, Bellfield and Bauch, 2016; Bellfield et al., 2017).

To reconcile WEF security targets and forest-conservation objectives it is recommended to undertake the following measures and actions:

- Reform the subsidy and tax system to “internalize” environmental and social externalities, promote more sustainable production and consumption patterns across sectors, make the polluter-pays principle operational, and take into account equity considerations (Burnett and Wada, 2018).
- Encourage the development of renewable energy technologies with the help of international financing, the development of non-conventional and innovative means of financing, and the removal of institutional, technical, regulatory and economic barriers (Halalsheh et al., 2018).
- Strengthen the nexus between non-conventional energy (renewable) and non-conventional water sources (treated wastewater and desalinated water) to address climate change mitigation and adaptation. Cross-sectoral projects still penalised by sectoral institutional landscape, should be encouraged to promote win-win options for nexus security and mitigation and adaptation objectives, bridging institutions, engaging stakeholders at different levels, and favouring unconventional funding mechanisms for nexus solutions.
- Incorporate the key principles of the green and circular economy into the WEF nexus through multi-functional production systems and cross-resources and cross-sector recycling. Incentivise green and circular economy adoption in WEF projects applying a mix of different policy instruments, including market and non-market instruments and strategies to harvest technological synergies, minimise waste and generate co-products and co-benefits.

The G20 countries should work together to protect and restore valuable ecosystems such as tropical forests, using blended finance structures to increase impactful investment in high-value nature locations. Institutional changes and adaptations should also be carried out towards integrated, bottom-up and co-governance approaches.

DEVELOP SUSTAINABLE WEF INTRA-REGIONAL AND INTER-REGIONAL COOPERATION/INTEGRATION MODELS BASED ON THE PRINCIPLE OF COMPARATIVE ADVANTAGES

As the WEF nexus approach helps to enhance complementarities and synergies across the three sectors, when it crosses national borders prompting countries to cooperate taking as reference their relative comparative advantages, the potential net benefits may increase. This approach should be adopted at both intra-regional and inter-regional level, considering the differences and variation in factor endowments at country level (IUCN ROWA, 2019). At regional level, the WEF nexus approach provides opportunity for building regional resilience to climate change, mitigating vulnerabilities through coordinated WEF infrastructure

development, improved management of transboundary natural resources, and optimising regional comparative advantages for WEF production. The MENA region may gain from the mutual dependencies triggered by this model of regionally integrated water and energy sectors, enforcing interdependencies among countries and addressing water, energy and food security in an economically efficient and environmentally sound manner (Shannak et al., 2018). The Pre-Feasibility Study for Mid-East Water-Renewable Energy Exchanges carried out jointly by EcoPeace Middle East and the Konrad-Adenauer-Stiftung (2017) demonstrates the potential benefits when the nexus approach crosses national borders. At the interregional level, by incorporating the concept of comparative advantages into the WEF nexus framework, great opportunities may arise from hidden virtual flows of WEF embodied in international trade, with significant economic, political and environmental benefits. Fostering transboundary cooperation and enforce interdependencies among countries, may address WEF security in an economically efficient and environmentally sound manner and simultaneously help countries to meet their targets set by the Paris Agreement (Kennou et al., 2018; Shannak et al., 2018).

To foster sustainable WEF cooperation/integration models, it is recommended to undertake the following measures and actions:

- Incorporate the comparative advantages concept into the WEF nexus.
- Develop regional outlooks on WEF resources to highlight inter-variability among countries and make effective use of countries' comparative advantages.
- Elaborate footprint assessments of natural resources as effective tools for exploring options for resources reallocation among sectors and quantifying the impacts of policy measures on the WEF nexus and the environment.
- Promote a nexus approach as a strategic starting point for capacity-building activities and agreements to share data and information systems.
- Design trade policies to ensure the integration and complementarities of WEF policies.
- Invest and trade in green and efficient water, energy and agricultural technologies in order to contribute to the integrated and sustainable planning and management of resources.
- Promote trade agreements to improve cross-border cooperation to build WEF exchange models based on countries' comparative advantages.

The G20 can take a strong role in guiding both intra-regional and inter-regional cooperation based on the principle of comparative advantages, removing barriers and introducing

incentives to cooperation mechanisms as well as associating countries in coordinating common WEF strategies, and harmonising regulatory and technical standards.

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