



ACCELERATING SDG 7 ACHIEVEMENT

POLICY BRIEF 09

WATER-ENERGY-FOOD NEXUS FOR
THE REVIEW OF SDG 7

7 AFFORDABLE AND
CLEAN ENERGY



POLICY BRIEF #9

WATER-ENERGY-FOOD NEXUS FOR THE REVIEW OF SDG 7

Developed by

Food and Agriculture Organization (FAO)

In collaboration with

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KEY MESSAGES

Status of the Water-Energy-Food Nexus approach and progress towards achieving the SDGs

- The Water-Energy-Food (WEF) Nexus is a policy and planning approach designed to manage trade-offs and synergies in addressing the challenges of simultaneous demands for huge increases in water, energy and food supplies over the next decades. The importance of each these sectors is evidenced by the fact that they have their specific SDGs. At the same time, they also contribute significantly to several other SDGs, and to the implementation of the Paris Agreement.
- The WEF Nexus approach is increasingly used at the project level and supported by some governments, civil society organizations, international development partners, the private sector and research institutions, but progress has been much slower in mainstreaming the Nexus approach into policymaking, institutional contexts and planning processes.
- Implementation of the WEF Nexus approach faces a number of challenges, which can vary depending on country situations and geography (e.g., sharing a trans-boundary river basin). However, governance issues are the most challenging, including a lack of policy coherence, institutional coordination and information, as well as stakeholder power differences and politics at different levels. Another concern is that despite a strong gender dimension in the WEF sectors, gender aspects are often overlooked in the use of the WEF Nexus approach.
- There are resources that can support the adoption of the WEF Nexus approach, including well-proven WEF Nexus technologies, tools and practices. Key advantages of the Nexus approach for operators are that it reduces costs and risks and attracts increased investments and financial support. It also offers opportunities for stakeholder dialogues and public awareness-raising.

Given the challenges in mainstreaming the use of the WEF Nexus in policies and programmes, actions to that end should adopt a step-wise process through practical approaches, which might be better than striving for the “ideal”.

Priority actions

- Document, advertise and further support practical cases where the use of the WEF Nexus approach has led to successful outcomes.
- Fill knowledge gaps, in particular through support to knowledge platforms and the improvement of data collection relevant to the WEF sectors.
- Strengthen attention to gender aspects, and financial support to SMEs that embrace the WEF Nexus approach.
- Keep fostering multi-stakeholder dialogues at all levels and with a wide variety of partners, including the private sector. Prioritize capacity development at the local government and community levels as a basis for incorporating WEF Nexus decision-making into actions related to the WEF sectors.
- Strengthen participatory approaches and address power differences, in particular regarding the implementation of WEF-related interventions at the local level.
- Strengthen the capacity of national decision makers relevant to the WEF sectors, building on existing structures and mechanisms as much as possible, but also seeking new avenues for collaboration.
- Promote horizontal and vertical coordination in planning WEF-Nexus relevant action

Introduction

Agriculture is the largest user of the world's freshwater resources, accounting for 70 per cent of total global water withdrawals (FAO, 2011a). The energy sector (primary energy production and electricity generation) accounts for only 10 per cent of water withdrawals and 3 per cent of total global water consumption (IEA, 2016). An estimated 30 per cent of global energy consumption occurs along food supply chains (FAO, 2011b), and the water sector accounts for 4 per cent of total global electricity consumption (IEA, 2016), while the energy supply sector accounts for nearly 15 per cent of global freshwater withdrawals annually (IRENA, 2015). Without adequate water and energy, global food needs cannot be met.

At the same time, cities and industry, too, claim increasingly more water, energy, food, and land resources. The challenge of managing simultaneous demand and supply in the water, energy and food sectors will be exacerbated in the near future if we continue with “business-as usual”. Feeding a global population that is expected to reach 9.8 billion people by 2050 will require a 60 per cent increase in food production (compared with 2012 levels) and substantial avoidance of food losses along value chains. Global energy consumption is projected to grow by almost 30 per cent between 2016 and 2040 according to IEA's New Policies Scenario (IEA, 2017). Total global water withdrawals for irrigation are projected to increase by 10 per cent by 2050 (FAO, 2011a), but less than 2 per cent by 2040 for the energy sector, from 2014. However, energy-related water consumption would rise by 60 per cent (IEA, 2016).

An integrated approach is required to account for the close links between water, energy and food in addressing the daunting challenge of fulfilling simultaneous demands in a sustainable manner. The Water-Energy-Food (WEF) Nexus offers an approach to sector planning, policy and technology decisions that identifies potential trade-offs and explores synergies in their production and use, taking into account the finite amounts of (and often stressed) natural resource assets and the challenges of climate change. More broadly, the WEF Nexus addresses some of the key development challenges of our age—growing demands for goods and services related to population growth, rapid urbanization, changing diets and economic development—through equitable and sound management of resources within planetary boundaries and in the context of climate change.

Links between the Water-Energy-Food Nexus, the Sustainable Development Goals and the Paris Agreement

Although water, energy, and food security are recognized as SDGs in their own right, progress towards the majority of the SDGs is directly related to the sustainable use of resources such as land, food, water, and energy. WEF Nexus knowledge platforms and stakeholder dialogues can serve as “bridging institutions” for

different stakeholders in achieving the SDGs (including SDG 17—Partnerships for the Goals).

The WEF Nexus approach can help in the implementation of the SDGs in at least three ways:

- Identify potential trade-offs at the policy design stage (e.g., targets related to food security, bioenergy and thermal power capacity additions);
- Support the identification and development of solutions that positively benefit multiple SDGs (e.g., decentralized renewables in agri-food);
- Better link SDGs in their implementation through a process that avoids the “silo” approach, which prevailed with the MDGs.

There are particularly close interlinkages between the WEF Nexus and climate change, which makes this approach especially relevant to implementation of the Paris Agreement (SEI, 2011). Energy and food/agricultural production are major drivers of climate change, and at the same time, agriculture and water are among the most climate-vulnerable sectors.

Climate policies can improve water, energy and food security (e.g., through afforestation, soil carbon sequestration and renewable energy), but they can also negatively impact, or be impacted by, WEF resources. For instance, promotion of renewable energy that consumes water might lead to CO₂ reduction, but also to an unsustainable increase in water demand. Similarly, diminished water availability due to climate conditions might limit the renewable energy-related climate strategies a location could pursue. At the same time, policies and practices related to the WEF sectors—such as those included in climate-smart agriculture and smarter energy solutions resulting from digitization, can offer solutions to both climate change mitigation and adaptation. Furthermore, and in rural developing economies in South Asia and sub-Saharan Africa, a switch from solid biomass (wood, agricultural residue, animal dung) to clean cooking fuels can be part of the solution to reduce carbon emissions and increase carbon retention in trees, while also improving the quality of soils for agriculture.

The inclusion of gender concerns in the WEF Nexus approach shows us how women's work currently facilitates access to water and energy for small-scale agriculture, productive enterprises, and household uses in rural developing countries, while policies to improve women's access to (pumped) water and modern energy sources can support increased production of food, economic development and women's empowerment. The analysis of the roles and contributions of women and men in the water, energy and food sectors helps in understanding the importance of women food producers, yet at the

same time their exclusion from rights to own and control critical factors of production (Kelkar et al., 2017). This analysis highlights the need for gender sensitivity in the design and management of WEF Nexus actions. Inadequate attention is currently being paid to reducing gender imbalances in household decision-making related to WEF matters (e.g., agricultural practices, water use, cooking fuel) (Nathan et al., 2018, forthcoming), but gender considerations are beginning to be systematically included in the WEF Nexus work of some organizations, such as the Commonwealth Scientific and Industrial Research Organization. CSIRO, 2017).

Status of implementation of the WEF-Nexus Approach

Due to its importance in achieving both the SDGs and the Paris Agreement, the WEF Nexus approach has recently received increased attention in international initiatives (e.g., SEforAll and the World Economic Forum) as well as support from the research/academic sector, governments, the private sector and international development partners.

To date, there are very few examples of mainstreaming the WEF Nexus approach in national policies, programmes and institutions—though it has been introduced to some extent in Austria, Germany, Mauritius and Qatar. In part, this is explained by governance challenges discussed later.

However, the approach is increasingly being used at the project level, often with support from international development partners and/or the private sector. Food producers (farmers and/or agri-food companies) are accustomed to managing their production according to the availability of water and energy. However, the increased risks of resource scarcity, associated with the realities of climate change, require them to “change gears” in addressing these challenges.

Challenges and opportunities

While the trends that give impetus to adopting a WEF Nexus approach are global in nature, the implications and challenges vary according to different contexts (OFID, 2017).

For low-income countries, the highest priority is to simultaneously close the large energy, water and food security gaps. Access to data, technologies, knowledge, and finance is key for setting up viable business models and developing integrated nexus solutions—particularly in agriculture—and can help accelerate progress towards sustainable development and poverty reduction.

Emerging economies have witnessed rapid growth, which also means increased consumption of goods and services per capita, including regarding the WEF sectors. A focus on resource-use efficiency and good governance will ensure adequate, inclusive and sustainable supply of water, energy and food under these circumstances.

Industrialized countries have higher per capita resource demands, and large external resource footprints that put pressure on resources. In this case, the challenge is to substantially reduce their footprints while ensuring adequate economic growth.

Given the nature of the WEF Nexus (i.e., cross-sectoral and focused on key resources for people’s livelihoods, ensuring policy coherence and good governance are crucial for its sound and fair implementation. Until very recently, implementation focused primarily on technical solutions, whereas governance did not receive much consideration, particularly in the context of the institutions and politics governing the WEF sectors. WEF Nexus decisions are often based more on political than technical factors because the current reality of increased resource demand, scarcity and climate change impacts, means that decisions on the production and use of WEF resources entail trade-offs—and hence winners and losers (Scott, 2017; Weitz et al., 2017). Stakeholder differences in knowledge, and ultimately power, often prevail in WEF Nexus area decision-making. Therefore, one has to go beyond trade-offs and synergies in considering WEF nexus issues, and better understand the nature of stakeholder interactions in dealing with these issues.

One important factor is that limited information undermines evidence-based decision-making. This is frequently owing to the lack of reliable and up-to-date data on the status of the WEF sectors, as well as insufficient awareness of the benefits of using the WEF Nexus approach by relevant sector players and inadequate accounting of externalities due to low or no pricing of water and energy use, particularly in developing countries.

Within governments, there may be lack of motivation to coordinate by relevant sectoral bodies because the transaction costs of coordination are perceived to be higher than the benefits. Therefore, besides awareness of the benefits, incentives to collaborate are also needed. Fragmentation is sometimes compounded by international and bilateral development support, and different priorities among the sectors (line ministries) often hinder collaboration with other sectors and long-term planning.

Ministries/institutions with an overarching mandate (bridging institutions) like trans-boundary river commissions or planning ministries/environmental ministries are sometimes in a better position to take up and promote the WEF Nexus approach. The management of international trans-boundary river basins presents specific challenges concerning politics, diversity of scales and perspectives, and the importance of state actors; applying the WEF Nexus approach can help to address such challenges through a more integrated and inclusive approach that can alter existing actor dynamics (Keskinen et al., 2016).

Companies offering WEF Nexus solutions to small and medium-sized players in the agri-food value chains are mostly innovative, early-phase enterprises with a common problem regarding access

to adequate finance. In order to attract investment and enlarge their businesses or “build scale”, these entities need de-risking mechanisms and enablers of access to higher levels of finance. Some financial support mechanisms for WEF small and medium-sized enterprises are emerging—such as the OFID-REEEP WEF Nexus Revolving Capital Pool (OFID, 2016). At the same time, some interesting ways exist to address the challenges related to the WEF Nexus.

There are several ways to reduce the energy footprint in the water sector, including improved energy efficiency (e.g., in irrigation), energy recovery (e.g., in wastewater treatment, which can also produce energy), and reduced leaks, which waste both water and energy. The freshwater footprint of the energy sector can be reduced through greater use of alternative water sources, water recycling and improved efficiency in the power plant fleet. The energy sector can also provide the agricultural sector with its produced water after treatment, as is being done by some oil/gas companies in the US. Carbon and water footprints can be useful tools for measuring and monitoring, and low footprints can also be valuable assets in marketing products (UNESCO, 2012).

Farmers and private sector companies are usually interested in water- and/or energy-saving practices that reduce their operational expenses and also contribute to de-risking their operations in situations where these resources are or might become scarcer (REEEP, 2014). Several efforts are being undertaken to integrate water and energy planning (IRENA, 2017). The World Bank’s “Thirsty Energy” work in South Africa is an example of this (World Bank, 2017).

The use of renewable energy can, depending on the technology used and local conditions, have significant positive effects on optimizing water use while ensuring enough food production. However, this can also face several constraints, as shown by the cost-benefit analysis (both monetized and non-monetized) of introducing renewable energy in selected food value chains, which was recently undertaken by FAO (FAO 2017 a and b). In particular, non-monetized costs of women’s labour, whether in cultivation or cooking, are ignored in cost-benefit calculations, leading to an overuse of both women’s labour and the biomass extracted with it (Nathan et al., 2018, forthcoming).

WEF Nexus-related investments contribute substantially to achieving all SDGs, and these investments are promoted in the agendas of both national governments and development finance institutions. For example, OFID’s Corporate Plan 2016-2025 expresses the institution’s readiness to mobilize resources to tackle energy, water and food security in an integrated way (OFID, 2017). Indeed, over the coming decade, OFID will commit 70 per cent of its funding to the WEF sectors, plus transportation as an enabling component.

Inclusive governance in the WEF sectors can contribute to addressing power imbalances between different actors, as well as different levels of government, including through stakeholder dialogues—such as the recent EU/BMZ-funded WEF Nexus Regional Dialogue Programme, the ESCWA Water-Energy Nexus and Water-Food Nexus Projects in the Arab Region, and the “Integrating Approach” used in Colombia.

Recommendations on scaling up the use of the WEF Nexus approach

Scaling up successful WEF nexus experiences would require a major paradigm shift in the fragmented way programmes are currently implemented in the WEF sectors. This will not be easy and will not happen overnight. From a pragmatic point of view, this means that developing a step-wise process through practical approaches might be better than striving for the “ideal” (Scott, 2015).

The following recommendations in that direction are proposed:

- a) As regards *political/institutional aspects*:
 - **Take into consideration the political economy of solutions put forward** Make analysis of political systems, stakeholders and power relations an integral part of all suggestions/solutions for WEF-nexus issues. Solutions should be formulated that promote policy coherence as well as an enabling environment (access to information, rule of law, etc.).
 - **Build effective, accountable and inclusive institutions at all levels** Integrate the building and/or strengthening of institutions into policymaking for, and implementation of, WEF-nexus approaches. Effective, accountable and inclusive institutions as well as rule-based regulatory/legal environments are crucial in promoting a participatory and citizen-oriented implementation of actions related to the WEF sectors.
 - **Strengthen local NGOs**, given their close links with local populations, hence their key role in raising awareness and facilitating implementation of development actions (UN ESCWA, 2013).
 - **Prioritize capacity strengthening of decentralized government institutions** Indeed, it is decision-making at the local level that will largely determine how trade-offs and synergies in the WEF nexus are implemented, when promoting the WEF Nexus approach with governmental institutions. Emphasize the efficiency gains and the conflict prevention potential of the Nexus approach, despite higher upfront costs of inter-sectoral coordination and planning. Enable broad stakeholder involvement, not only at the governmental level, but also for citizens, in order to allow

for bottom-up solutions, knowledge sharing and conflict mitigation.

- **Support both horizontal and vertical coordination** Both types of coordination may often be met with resistance. Progress regarding the above-mentioned interventions, in particular those related to stakeholder processes and capacity-building, have proven to strengthen such coordination in an unforced, somewhat “organic” way.

b) As regards *knowledge management*:

- **Document and advertise successful WEF Nexus management cases** because these help raise interest and provide the arguments for scaling up Nexus approaches.
- **Improve the knowledge basis** regarding WEF Nexus’ current and future status. IRENA (2015) has reviewed the most common WEF Nexus tools. Most of them concern scenarios based on modelling, however, FAO proposes two tools that are based on existing situations: the nexus assessment methodology (FAO, 2014), and the cost-benefit analysis of clean energy technologies in agri-food chains (FAO, 2017 a and b).
- **Fill knowledge gaps and collect and make data available**, including on water consumption in the energy sector; energy utilization across the water supply chain; water and energy use and needs at all stages of agri-food chains; environmental impacts on the use of water, energy and land in food production; GHG emissions; and social impacts (employment, and gender considerations).
- **Support interregional/international exchange of experiences** on the use the Nexus approach in planning and policymaking. Provide case studies/good practices; which can be transferred to other national/regional contexts. Knowledge platforms such as the Germany/EU-funded WEF Nexus Resource Platform (GIZ, 2016a) and the energypedia/Powering Agriculture portal (Energypedia, 2018a) provide good examples about sharing nexus experience and information.

c) As regards *appropriate technologies and good practices*:

- **Promote well-proven technologies in all the WEF sectors.** Social acceptance, risks, workloads and opportunity costs have to be sufficiently taken into account when promoting these technologies.
- Where possible, **co-locate water and energy infrastructure**, allowing the waste stream of one to be utilized by the other (or by the agricultural sector), allowing for a reduction in by-products, minimization of transportation costs and lower energy and water requirements.

- **Strengthen capacities of WEF resource users** Make WEF sector stakeholders aware of the risks associated with inappropriate use of water and energy, and then enable them to employ clean energy as well as energy- and water-efficient technologies and practices. The capacity of direct resource users to assess options, make informed decisions on investment, handle technologies, and access finance, is key for scaling up the Nexus approach. Awareness and Information of consumers on sustainable energy use is also important in order to create a demand to buy these products. Concrete examples of capacity development include the GIZ/FAO Toolbox on Solar Powered Irrigation Systems (Energypedia, 2018b) to strengthen skills in Nexus technology, and the OFID-REEEP WEF Nexus Revolving Capital Pool regarding financial support mechanisms (OFID, 2016).

d) As regards stakeholder processes:

- **Foster stakeholder dialogue** at different levels (especially public/private sector engagement): An interesting experience at the regional level concerns the EU/BMZ-funded WEF Nexus Regional Dialogue Programme (GIZ, 2016b), and the “Integrating Approach” used in Colombia to implement SDGs (Communitas Coalition, 2013) provides a good example of fruitful and inclusive dialogue at national level;
- Strengthen participatory approaches and address power differences, including differences related to gender, as these are often crucial in achieving sustainable and equitable implementation of actions related to the WEF sectors. The WEF Nexus approach adds to the typical stakeholder processes an element of equality between sectors, which helps in addressing power differences. IIED has developed one of the few compilations on “power tools”, which are also relevant to WEF Nexus implementation (IIED 2001).

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