

EDITORIAL

Water-Energy-Food-Ecosystem (WEFE) Nexus: A key concept for a more resilient adaptation to the climate crisis

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The Water-Energy-Food-Ecosystem (WEFE) Nexus is a pretty novel cross-thinking concept, meaning that answers to current environmental hazards must follow a multisectoral approach rather than a traditional unidirectional vision^[1]. Since water supply, energy flows, and food security—and its connection with the surrounding ecosystems—are intimately linked together, every impact in one of such areas will have undoubtedly impacts on the others. The most important significance of the WEFE Nexus approach is that further exploitation of clean water supplies, agricultural soils, and energy resources should not destabilize nor weaken the provision of these ecoservices to the current and future societies. The Nexus approach has often been defined in another ways, but always conducting to the same idea. For example, most authors have been using the traditional terminology WEF (Water-Energy-Food), others mix the components in a different order (e.g., FEW and EWF), and some others define it by a multiplicity of combinations, such as LWE (Land-Water-Energy Nexus), WLF (Water-Land-Food), LWEF (Land-Water-Energy-Food) or WLEFC (Water-Land-Energy-Food-Climate)^[1-3]. Collectively, all these terminologies aim to demonstrate the complexity of the Nexus thinking, even by including some new terms related with other relevant elements like Land or Climate. Just to give some examples of the multiple interactions and strong linkages between Water-Energy-Food-Ecosystem, Bidoglio *et al.*^[2] explain that, e.g., water could be used for power generation (i.e., hydropower), while at the same time large amounts of energy may require pumping water, and maybe also to treat and/or to desalinate part of such water, and both water (irrigation) and energy uses (fuels) are then a requisite for food production, mobilization and distribution. But, at the same time, using water for crop irrigation and food production can also reduce river flows and hydropower potential, as well as affecting water quality and aquatic ecosystems health. On the other hand, obtaining bioenergy from crops (e.g., biofuels) under irrigated agriculture can increase overall water withdrawals affecting food security. In another

example, converting surface irrigation into high-efficient pressurized irrigation may save water, but at expenses of a higher need for energy consumption. Therefore, every single action over one of such WEFE resources will affect at least to one or even all of the others. In such sense, the WEFE Nexus could account for all this complexity and multiple scenarios, and in the best of the cases, can be a driver to recognize the less impactful one^[1,3].

So, an integrated management of the natural resources, as proposed by the WEFE Nexus thinking, seems to be also the key to simultaneously achieve several of the Sustainable Development Goals (SDGs) adopted by the United Nations in 2015^[4]. The actions are universal ones aimed to end poverty, protect the planet, and ensure food, water and energy security for all people by 2030^[5]. Indeed, if we consider all the tradeoffs and synergies linked in the WEFE Nexus approach, it could be possible to effectively meet with different interdependent SDGs, such as SDG 6 (clean water), SDG 7 (clean energy), SDG 2 (zero hunger), SDG 14 (life below water), and SDG 15 (life on land). In fact, all the 17 SDGs recognize that an action in one particular area will affect outcomes in the others, and that development must be social balanced and economically and environmentally sustainable^[4]. Therefore, these goals also follow a kind of Nexus thinking wherein the creativity, know-how, technology, scientific research, and financial resources are priorities for truly achieve all these goals, in each particular context.

In general, policy makers, local administrations, national governments and also some of the most recognized international organizations have separate departments or ministries for dealing with production, environment, energy, agriculture, research, etc. They often define and implement policies for each sector in a separate way^[2]. The same is true for research activities, where frequently different knowledges related with bio-energy production, water management (e.g., purification, treatment, and reuse) and food technology (development, production, quality, etc.) are clustered in separate working groups, with often limited interaction between them. Therefore, inter and cross-

institutional research, connecting different countries with similar problems, is a need to overcome current and future demands trigger by the progressive climate change^[6]. The Nexus approach recognizes that water, energy, food and ecosystems are closely linked together, through global and local resources. So, developing an effective WEFE Nexus approach is important to recognize and validate an array of options and measures to adapt to specific local sites and conditions, but also some others could be used in a wider sense for applying to more global needs^[1,3]. Therefore, it is a priority for policy makers, administrations, stakeholders, and the common society to overwhelm the traditional view on natural resources as merely individual and disconnected assets. In such sense, promoting knowledge acquisition and transfer, educational actions and up-dated scientific-based regulations, that introduce the notion of the WEFE Nexus approach, is crucial, since prepared communities will be more resilient to react, adapt, and recover from the ongoing climate crisis.

Conflict of interest

The author declares no conflict of interest.

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