



# 9th Meeting of G20 Agricultural Chief Scientists (MACS-G20) *Khobar, Kingdom of Saudi Arabia* *18-19 February 2020*



## Concept Paper: Water Energy Food Nexus to Curtail Future Food Uncertainties

### I. Rationale

Increases in consumption along with rapid population increase are posing huge pressure on global demand for water, energy, and food. Energy and water are closely interlinked in many ways and both the industries are interdependent. Energy industry is water-intensive consuming water for resource extraction, conversion, transportation and power generation. On the other hand, water industry is energy-intensive, consuming electricity for desalination, pumping, and wastewater treatment<sup>1</sup>. The water/energy link represents a critical tradeoff and possible to constraint to agricultural production. Agriculture being the largest user of global freshwater resources also utilizes more than one-quarter of global energy output for food production, distribution, and utilization<sup>2</sup>. The efficient use of water and energy is crucial to meet the increasing demand for food, while also ensuring and expanding access to safe drinking water and ensuring the availability of water for other uses. The interdependence of water, energy, and food conceives the concept of Water Energy Food (WEF) Nexus for resource use efficiency, improved livelihood, improved health, and economic benefits. In order to use and manage our limited resources sustainably, WEF Nexus demands integrated approach for freshwater management through improved surface irrigation methods to use water more efficiently, and energy-efficient sustainable agricultural practices to reduce the cost and energy demand of food production. The WEF Nexus has enormous potential for increasing food

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<sup>1</sup> Mielke, Erik, Diaz Anadon, Laura, and Narayanamurti, Venkatesh, "Water Consumption of Energy Resource Extraction, Processing, and Conversion. Energy Technology Innovation Policy Discussion Paper No. 2010- 15, Belfer Center for Science and International Affairs, Harvard Kennedy School, Harvard University, October 2010.

<sup>2</sup> FAO. 2011. Energy-smart food for people and climate. Issue Paper. Rome: Food and Agriculture Organization of the United Nations.

production by benefitting from recent, innovative and advanced technologies. The WEF Nexus is selected for the ninth MACS G20 due to its vision of responsible and efficient use of natural resources for sustainable food production to eradicate hunger and poverty.

## II. Background

Water, energy and food security are key pillars of sustainable development, human well-being, and rural poverty reduction. Currently, 844 million people of the world lack access to safe drinking water<sup>3</sup>, roughly 840 million people have no access to electricity<sup>4</sup>, and approximately 821 million out of 7.6 billion people in the world do not have enough food to eat<sup>5</sup> or to meet their daily dietary requirements. In terms of food projections, the situation is projected to exacerbate by 2050 as the world needs to produce 60 percent more food to feed 9.15 billion population<sup>6</sup>. However, the uncertainties in climate change, land degradation, extinction of biodiversity due to population growth, economic development, changes in freshwater availability, and changing consumption patterns aggravate the difficulty in achieving the Sustainable Development Goals (SDGs) by 2030.

The rapid population growth, ongoing urbanization and consumption, and environmental disruption are adding great pressure on water, and energy resources for food production. Agriculture is the largest user of freshwater and accounts for over 70 percent of the total water use globally, though that number varies significantly at regional and local scales. In addition to the use of water for crop production, it also plays a very important role throughout the agri-food supply chain. Overall, water

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<sup>3</sup> Carolynne Wheeler (2018), The water gap: The State of the World's Water 2018. Retrieved from Analysis and Policy Observatory Website: <https://apo.org.au/node/137041>.

<sup>4</sup> IEA, IRENA, UNSD, WB, WHO (2019), Tracking SDG 7: The Energy Progress Report 2019, Washington DC

<sup>5</sup> FAO, IFAD, UNICEF, WFP and WHO. 2019. The State of Food Security and Nutrition in the World 2019. Safeguarding against economic slowdowns and downturns. Rome, FAO. Licence: CC BY-NC-SA 3.0 IGO.

<sup>6</sup> Alexandratos, N. and J. Bruinsma. 2012. World agriculture towards 2030/2050: the 2012 revision. ESA Working paper No. 12-03. Rome, FAO.

withdrawals are expected to increase continuously leading towards increased water scarcity, particularly if national-level systemic improvements in water resources management are not urgently put into place.

On average 30 percent of the total global energy is consumed by the agriculture sector for food production, transportation, distribution, and consumption. According to an estimate by the International Energy Agency (IEA), the world's energy consumption is expected to increase by 50 percent in 2035 and to increase by 80 percent in the next 30 years, with a transition towards low carbon energy mixes. Both water and energy are inherently linked and mutually reinforce aggravate the food insecurity crisis, if not efficiently managed. Promoting energy and water-saving efficient technologies for food production and supply chain will alleviate pressure on water resources and energy sources. The extra saved valuable resources could either be saved or re-allocated to produce more food, deliver sustainable drinking water services, and replenish environmental systems, which ultimately secures the livelihood and uplifts the socio-economic status of the poor.

Water Energy Food Nexus is an approach to improve efficiencies in the use of valuable finite resources. Their interactions in terms of synergies and trade-offs provide security and sustainability to WEF Nexus. This multidimensional approach deals with all possible issues involved in resource depletion and food security. Post-harvest losses, including waste in food value chains is one of the key drivers in both water and energy inefficiency. The initial estimates from the FAO newly developed Food Loss Index (FLI) indices indicated around 14 percent of global food losses (post-harvest to the retail level, but not including retail level) in terms of economic value<sup>7</sup>. However, previous estimates stated one third of food losses and waste from total production, this translates to wasting of 1.3 billion tonnes of food with 940 billion USD

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<sup>7</sup> FAO. 2019. The State of Food and Agriculture 2019. Moving forward on food loss and waste reduction. Rome. Licence: CC BY-NC-SA 3.0 IGO.

per annum, 1.63 Gha of land out of 4.9 arable land, 0.83 trillion m<sup>3</sup> of water, 8 percent GHG emissions, and 10 percent of global energy<sup>8</sup>.

Considering water, energy, and food solely in their individual capacity are not sustainable due to interconnection risks. It is of the utmost importance to focus on good research, which is critical to generate good water-energy interdependence data for food production. The logical analytical conclusions drawn through good analysis are the key priority areas for scientific research. The idea of WEF Nexus from THINKING to ACTING need policies for actions by keeping in mind the cost effectiveness of the technologies in order to change the behavior of the farmers to adapt appropriate agricultural practices. The WEF Nexus is important for the world due to water scarcity, energy shortage, and food security challenges.

The outcomes of the WEF Nexus approach will support the development of evidence-based policies regarding the responsible use of water and energy resources for achieving food security.

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<sup>8</sup> Institute of Mechanical Engineers in their report stated that currently 4.9 Gha (Global hectares) or 4931 million hectares) out of 14.8 Gha (14894 million hectares) of land surface on the earth is under agricultural practices. About 30-50 % food losses mean 9.93 to 13.24 % of arable land out of total arable land. Agricultural production in addition uses 2.5 trillion m<sup>3</sup> of water per year and over 3% of the total global energy consumption.

### III. Proposed Future Collaborative Mechanism for G20 MACS 2020

1. Sharing of valuable knowledge through international collaboration with relevant International Organizations and interested G20 members in balancing the use of water and energy for food production. Furthermore, enhancing collaboration towards capacity development for the implementation of WEF Nexus solutions.
2. Interested G20 members and relevant International Organizations may contribute significantly for efficient use of the WEF Nexus approach through their cooperation by sharing data capturing the latest monitoring technologies for better understanding of Nexus components intersect.
3. Kingdom of Saudi Arabia is proposing to hold an International workshop later in the year on WEF Nexus in collaboration with interested G20 members, and relevant International Organizations to exchange views and best practices for effective and efficient utilization of global resources

